

Independent Component Analysis in development of Chinese Agriculture insurance



Xiaoxia Chen
School of Economy and Law
University of Science and Technology of Liaoning Anshan
China
xiao_xia_chen@126.com

ABSTRACT: *Independent Component Analysis is a useful method to find some internal key element which play an important role in the development. This paper uses ICA to analyze agriculture insurance to try to find the major factor which has great impact. We take FastICA as analysis tool and designed parameters. According to the experiment results and prior knowledge, some key elements are picked up from the independent components. Then, further discussion is made to quest how the elements work. Finally, this paper gives some recommendations for benign development of agriculture insurance.*

Keywords: Independent Component Analysis, Agriculture Insurance, FastICA

Received: 17 August 2015, Revised 20 September 2015, Accepted 25 September 2015

© 2015 DLINE. All Rights Reserved

1. Introduction

Agriculture is important for every country, especially in China, considering the huge population, which is the core of the economic development. Also, we can say that it's an uncertain business, partly due to its high dependence on the weather. Agriculture is disaster-prone. Disasters happen frequently in China, when the rural people live tough life. Then Agriculture insurance may be a more attractive channel for government support to rural livelihoods and risk mitigation than ex-post disaster transfers, which offer no ex-ante guarantee to farmers and may therefore have limited impact on ex-ante decisions, or loan waiver or input subsidy programs, which may adversely distort behavior.

However, making the provision of agriculture insurance is a challenge task and how to popularize the appropriate provision is also a problem, especially in China the developing country with the frail agriculture infrastructure. In recent decades, the Chinese government increases capital investment on the insurance for agriculture. It also wants to form a comprehensive planned mechanism to mitigate the risks of natural perils on farm production.

Agriculture insurance has greater effect on motivating the output of farm production even than agriculture loan^[1]. According to the data published by the CIRC (China Insurance Regulatory Commission), from 2012 to 2014, agriculture insurance income grows rapidly:

In 2011, total amount of insurance income is 13.568 billion Yuan with an increase of 189 million Yuan comparing to 2010, and there costs 10.069 billion on premiums. In 2012, the total amount of income is 17.38 billion Yuan with the 28.1% year-on-

year growth, providing more than 652.3 billion Yuan premiums, more than 16 million people benefit from it. In 2013, the overall income is 24.06 billion Yuan with the 38.3% year-on-year growth, providing more than 900 billion Yuan premiums, more than 28.2 million people benefit from it. Particularly in the July 21 rainstorm disaster and Bolaven Typhoon.

However, Chinese agriculture insurance market is still in infancy. Though, November 2012, Agricultural insurance regulations was promulgated by China’s State Council, which formalizes specification for support measures, implying the government wants to regulate the agriculture insurance market. The narrow insurance coverage and insurance diversity shortage are prominent problems in popularizing agricultural insurance. How to stimulate the development of agriculture insurance effectively is another important issue. Researchers around the global focus on finding the inner factors which impact the insurance growth.

The literature^[2] conclude that the main factors impact on the demand for crop insurance is the expected income of farmers, income variety and the risk aversion rate. And then the literature^[3] tells us that, instead of risk aversion rate, what predominantly affect the purchasing enthusiasm for insurance is the fiscal subsidy^[4]. To draw the conclusion there are some inverse relationships between disaster assistance and insurance purchases. Their analysis also suggests that farmers which buy insurance and which receive disaster payments tend to have higher returns to farming. The literature^[5] take India as an example, it shows that viable premium rate need to cover pure risk, administrative cost and reasonable returns, which means some policy-oriented insurance should be adopted.

We can find that there exist many factors that have complex influence on the insurance purchasing behavior. This paper intends to find some components that are independent with others. Then we can take a deep analysis into them. Without uncertain interference, this paper draws some interesting results and organizes as follows. Section 2 summarizes the ICA (Independent Component Analysis) used in the paper to analyze data. Section 3 presents our procession and the result of analysis with ICA. Then, section 4 discusses the result obtained from the experiment. The final conclusion is given in section 5.

2. Independent Component Analysis

Independent component analysis (ICA) is original form the cocktail party problem, which define a situation that in a cocktail party where many people are speaking simultaneously, so we have some microphones, which located in different locations to record the signals which are weighted sum of speech signals emitted by these speakers. ICA is a method in which the goal is to find a linear representation of non-Gaussian data so that the components are statistically independent, or as independent as possible to settle the cocktail party problem. The ICA model can be described in Figure.1 as follows^[6].

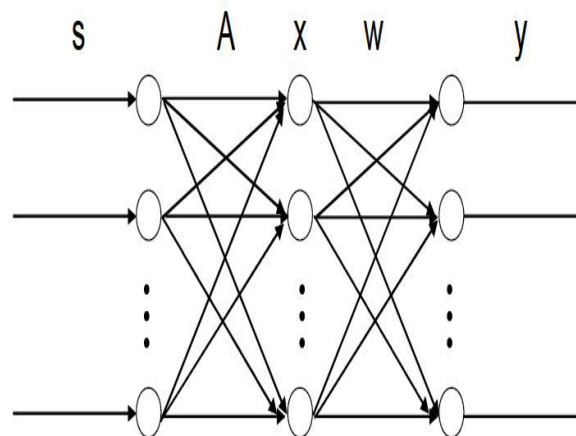


Figure 1. ICA model

Where S represents speakers, which is an n -dimensional random vector that assumed mutually independent, x is an observed m -dimensional vector. Let us denote S and X respectively $S = [s_1(t), s_2(t), s_N(t)]^T$, $X = [x_1(t), x_2(t), x_N(t)]^T$

The matrix X are generated as a linear mixture of n -dimensional independent components $s(t)$ denoted by $X = A \times S$ A is a hybrid matrix. Both the matrix A and the $s(t)$ are unaware, when we can only observe $x(t)$. In the real case, there is more

common to see noisy ICA model. The noisy ICA model can be expressed as: $X = A \times S + n$. Though estimating the matrix A , we can compute its inverse, say W , and obtain the independent component simply by: $S = W \times X$.

ICA is very closely related to the method called BSS (blind source separation) or blind signal separation. A source means here an original signal, i.e. independent component, like the speaker in a cocktail party problem. Blind means that we know very little, if anything, on the mixing matrix, and make little assumptions on the source signals. ICA is one method, perhaps the most widely used, during various areas such as feature extraction, blind signal separation, financial data analysis, vision procession, and so on.

In the financial sector, ICA can reveal the driving mechanism hiding behind the enormous data. Recent years, researcher find ICA is complementary of PCA (principle Component Analysis), which can expose the basic structure of data, to determine the elements push situation forward. The literature ^[7] shows the elements influence the stock market and the returns. ICA also can be a guide for policy maker to regulate the financial market. The literature ^[8] uses ICA to construct spot portfolio which has better linkage with stock index futures, whose result indicate that this method can achieve desired effect.

This paper inspired by the researchers above, we also try to use ICA to find the factors with essential function for the development of agriculture insurance.

3. Data Analysis

Domestic researchers focus on the factor that can give a positive impact on the growth of agriculture insurance. The literature ^[9] points out that the most essential factor impact the development of agriculture insurance is the fiscal subsidy. The literature ^[10] shows that during the fiscal subsidy high correlation shows up between insurance demand and farmers' income. The paper also mentions that the awareness of farmers is important either. The literature ^[11] via empirical analysis shows that the growth of agricultural production, farmers' income, disaster rate and governmental fiscal subsidy policy are the most vital factors to affect the development of China's agricultural insurance. Through the comparison between other countries ^[12], it finds the fact that Fiscal subsidy plays an important role in agriculture insurance, which displays a positive amplification effect on fiscal input. Take policy agriculture insurance ^[13] of Anshan city for example, it shows that combine the government, social power can implement the policy agriculture insurance quite well. It analyzes the plight of implement agriculture insurance ^[14] in Hebei prov., it finds that weak awareness of farmers on purchase insurance, low enthusiasm of insurance company, poor support by government and so on. Through constructing demand model ^[15] which parameterize some demand conditional ingredients showing that policy-oriented measures should be adopted. It points out that the contradiction between the farmers' objective needs for agricultural insurance ^[16] and the insufficient agricultural insurance products is widespread. The low quality of agricultural insurance products, the immaturity of catastrophe risk disperse system and the deficiency of transforming agricultural insurance research achievements into reality are handicap the evolution of agricultural insurance. It points that factors such as access ^[17] to credit, education, off-farm income, etc. have significantly influenced the adoption of insurance.

In this section we will analyze data obtained from Year book of China's statistics, Year book of China's agriculture, Year book of China's fiancé, Year book of China's insurance and other references. This paper excludes the data of some provinces where agriculture insurance is closed down during a period, and hasn't launched the rural compensation of agriculture insurance. We use the tool of FastICA to help analyzing data try to find the driving elements lay behind the enormous data.

3.1 FASTICA

FastICA is an efficient and popular algorithm for independent component analysis invented by Aapo Hyvärinen at Helsinki University of Technology. The following Figure 2 is the interface.

3.2 Data Proccession

Considering the factors impact on the development of agriculture insurance, this paper extract the following targets as the prior knowledge, they are:

a) Gross Agricultural production, is the price of total agricultural production from all the areas of China. It reflects the

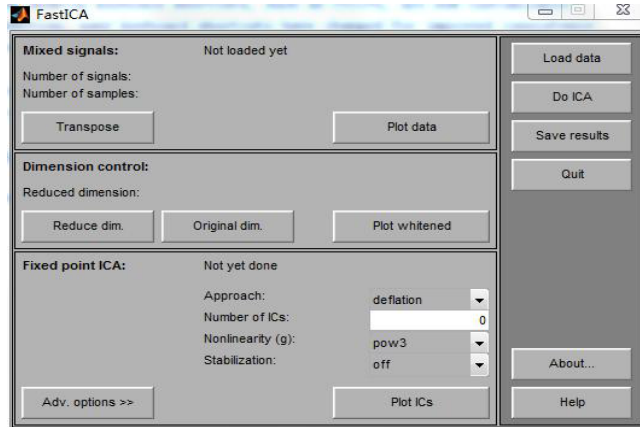


Figure 2. FastICA operator interface

development of the rural economy.

b) Annual per capita income of rural households is the disposable income of rural residents which reflects the income of the rural residents.

c) Agricultural disaster areas are the total areas affected by two main calamity, inundation and drought, which reflects the losses of the agriculture.

d) Agriculture insurance's proportion is the outcome of the division between agriculture insurance total income and property insurance total income.

e) Agricultural disaster relief is the financial subsidy for the disaster area to relieve rural resident who suffer from disaster at some extent.

f) Premium subsidy is the compensation from state finance to compensate rural people who purchase the agriculture insurances.

g) Culture factor in rural area is considered in this paper which can affect rural people for understanding the function of insurance to avoid risk.

As the input to the FastICA, we chose ten years' (2002-2011) agriculture insurance statistical data in months. Then we get a 12×10 Matrix, the following Figure 3 shows the details about the Matrix.

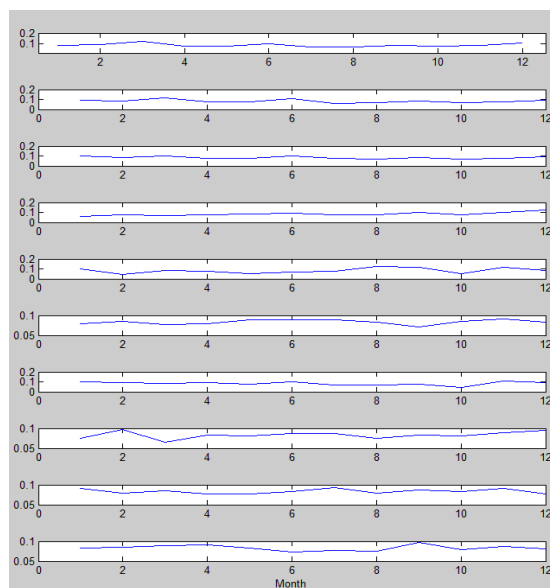


Figure 3. Statistical data of insurance income

After setting some parameters, Figure 4 shows the independent components as follows:

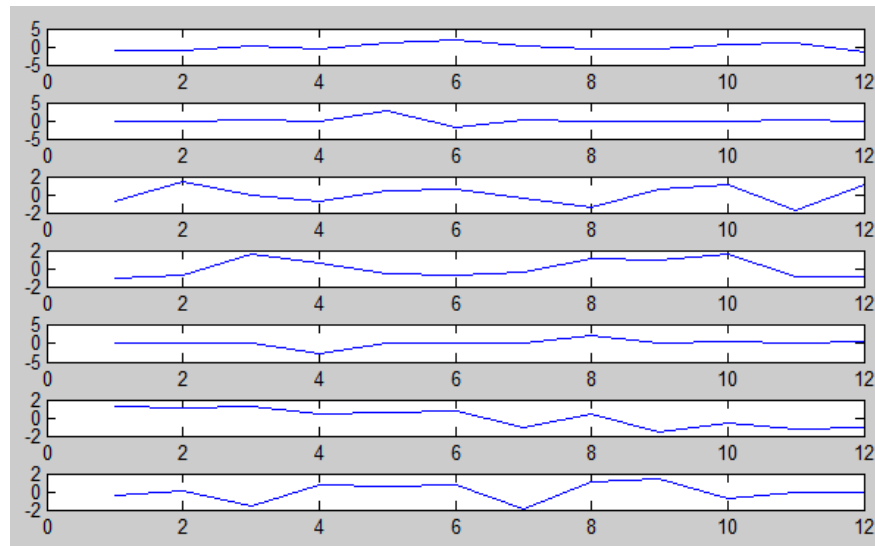


Figure 4. Independent components

Figure 4 gives five independent components. Because of the prior knowledge, we can find that the independent component which greater effect named the premium subsidy. Then, both annual per capita income of rural households and gross Agricultural production have notable impact. We can't find the culture fact works effectively. Finally, both disaster areas and the rural compensation have the least effect. In the next session we will get further discussion.

4. Discussion

Based on the result of FastICA we can get the following results:

- a) Premium subsidy plays a pivotal role which can significantly stimulate the enthusiasm of rural residents about the agriculture insurance which is the characteristic of China in the development of agriculture insurance. Therefore, to construct a government-finance-supported system is the premise that can guarantee agriculture insurance sustainable expansion.
- b) Gross Agricultural production and annual per capita income of rural households are key elements for the scale of agriculture insurance that are indexes of agriculture economic environment. Under the favorable economic environment, the disposable income can grow which means rural residents get enough capital to buy insurance.
- c) Disasters can't significantly stimulate rural residents' purchasing behavior that has various reasons. The main point is that the weak consciousness for avoiding risk which has little relation with the culture factor showing a fact that many rural residents have no knowledge about the insurance including what insurance for, what insurance can do and what rural residents need do. Therefore,
- d) Agricultural disaster relief is the most convenient way to get subsidy during disaster that has the least relation with the growth of agriculture insurance because of the Inertia of cogitation waiting for relief.

Therefore, we have some suggestion about our agriculture insurance:

- a) Ensure the growth of agricultural economics that can provide a favorable economic environment.
- b) Ensure the continued income growth and the disposable income of the rural residents.
- c) Increase state financial subsidies that can be treated according to different situation.
- d) Intensify propaganda of agriculture insurance to strengthen insurance awareness.
- e) Adjust the agricultural disaster relief appropriately in order to strengthening rural residents' insurance awareness.

5. Conclusion

This paper though independent component analysis to explore some key elements which affect growth of agriculture insurance. It is convincing that ICA is a useful way to probe the internal factors hiding behind the enormous data. According to the results, we could find some really interesting information about the insurance. Finally, we give some suggestion for agriculture insurance policy construction.

References

- [1] Wang, X. N. (2012). Agricultural loans, Effect of agricultural insurance on agricultural output-The evidence of Chinese level units from. 2004-2009, *Chinese rural economy*, (10), 44-51. (In Chinese)
- [2] Hazell, P. B., Pomareda, C., Valdés, A. (1985). Crop insurance for agricultural development: Issues and experience. International Food Policy Research Institute.
- [3] Just, R. E., Calvin, L, Quiggin, J. (1999). Adverse selection in crop insurance: Actuarial and asymmetric information incentives. *American Journal of Agricultural Economics*, 81 (4), 834-849.
- [4] Goodwin, B. K., Rejesus, R. M. (2008). Safety Nets or Trampolines? Federal Crop Insurance, Disaster Assistance, and the Farm Bill. *Journal of Agricultural and Applied Economics*, 40 (2), 415-429.
- [5] Bobade, A. H., Mahajan, S. S. (2012). Is the Crop Insurance a Remedy on Risk Management in Agriculture especially in Drought Prone Area?: It's Performance in Khatav Taluka of Satara District. *Review of Research*. 1 (5).
- [6] Yu, X., Lu, C., Shen. J. (2010). Denoising of tube-type bottle image based on independent component analysis and nonsubsampling contourlet transform. *In: 2nd International Conference on IEEE Signal Processing Systems (ICSPS)*.
- [7] Chen, Y. S., Xi, B. (2007). Application of independent component analysis in stock analysis. (In Chinese)
- [8] Cai, S. L. , Guo, C. H., Xu, X. (2012). The research on the optimal spot goods combined strategy construction in the stock index and futures interest arbitrage: *Planning and management*, 21 (2), 154-161. (In Chinese)
- [9] Wang, K., Duan, S. (2009). The empirical analysis of many factors affect on the development of agricultured insurance in China. *Insurance Research*, (4), 101-105. (In Chinese)
- [10] Liu, D. J., Zhang, X. S (2011) .The analysis of related factors of China's agricultural insurance demand. *Journal of Jiangxi University of Finance and Economics*, 5. 009. (In Chinese)
- [11] Wang, R. (2012). The empirical analysis of factors affecting the development of agricultural insurance in China. *Journal of Beijing Technology and Business University* (Social Science Edition, 27 (6). (In Chinese)
- [12] Fei, Z. (2011). Investigation on the Amplification Effect of Agricultural Insurance on Fiscal Input. *Insurance Studies*, 9: 002.
- [13] Chen, L. (2011). Discussion of the policy agricultural insurance development—Analysis based on the operation of the policy agricultural insurance in AnShan of liaoning province. *In: International Conference on IEEE E-Business and E-Government (ICEE)*.
- [14] Ling, M., Wang,W. -G,Wang, X. -Y. (2011). The Plights and Countermeasures in the Implementation of Distinctive Agriculture Insurance of Hebei Province. *Asian Agricultural Research*, 3 (03).
- [15] Huang, Y.-J., Lin, J.-W., ZOU, S.-Y. (20110). Model Construction and Theory Reconsideration on Demand for Agriculture Insurance *In: China. East China Economic Management*, 6: 013.
- [16] Juan, XiaoY., BuChun, L., Yuan, L. (2012). Practice and research progress on agriculture insurance in China during the past ten years, *Journal of Agricultural Science and Technology* (Beijing), 14 (2), 22-30.
- [17] Bodiul, A. (2012). Efficiency of insurance in agriculture of Republic Moldova in the market economy conditions. *Development*.