Journal of Fundamental and Applied Sciences

ISSN 1112-9867

Available online at http://www.jfas.info

Research Article

Special Issue

IMPROVING UNPRECEDENTED RESTLESSNESS AS THE NEW STRONG INDICATOR OF RICE CRISIS AT NATIONAL LEVEL

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Published online: 15 January 2018

ABSTRACT

Rice crisis that can happen sooner or later will give accurate and very important information about the predicted time of crisis in Indonesia. This paper was performed to improve and develop a new rice crisis indicator. The tested hypothesis i.e. unprecedented restlessness (UR) is the strong indicator of rice crisis. UR is tested massively in nineteen countries. This research has successfully identified that UR is a strong indicator for rice crisis at Asia level. Despite in the previous research, UR has passed two statistic tests namely rg and Q. However, both tests need to fulfill the success of probability (SP) and constraint probability (CP) in order to provide strong indicator properties. Thus, it is critical to assess the extent to which UR meets the above two criteria. This paper recommends UR can be used to assess the effectiveness of an agricultural plan in order to avoid rice crisis.

Keywords: success probability; constraint probability; uncontrollable riot; validity; MI-CHART.

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doi: http://dx.doi.org/10.4314/jfas.v10i1s.9

1. INTRODUCTION

Rice crisis is defined as a situation in which a prolonged uncontrollable riot occurs because of rice scarcity [1]. This definition is inspired by the thought that crisis can be stated compactly as a situation when intolerable bad things happen [2], the keyword is not just a bad things but intolerable bad things. What is the uncontrollable riot which we are so afraid of? The suggested riot scaling systems have not yet accepted globally. However, there were horrific food-related riots in the year 2008 that received global attention. The severity of the situation during those years was widely reported. A summary report of food riots that erupted across the globe in 2008 outlines state responses to the food riots and sketches the state of democracy in countries where riots occurred [3]. As stated in the previous study, we perceive the riots happening in the year 2008 as the prolonged uncontrollable ones.

2. METHODOLOGY

Why did people riot uncontrollably in the year 2008? It is obvious that people riot because they feel restless. They feel restless when their life burden becomes heavier. However, life burden is likely to change and the change is expected not to be favorable to people because supplies increase arithmetically while consumptions increase geometrically [4]. People rioted uncontrollably in 2008 is because people felt an extraordinary burden in 2008. The burden was so unusual and we call the burden of life in 2008 was unprecedented. This unprecedented burden led to unprecedented restlessness and forced people to riot uncontrollably eventually. The procedures for establishing the right, valid and reliable model is the main problem in modeling [5]. Modelling of the new rice crisis indicator is no exception.

In [1] developed restlessness ratio to quantify the burden of life. The paper developed the concept of rice related restlessness ratio to quantify the life burden in rice affordability context at the national level. Rice price-to-income ratio is the key issue for rice affordability. It shows nation's costs in relation to its income. The ratio gives us a clear view-the lower it is, the more affordable it will be. Changes in the ratio can also highlight potential problems: if the ratio rises greater from one period to the next, it means that prices are rising at a higher rate than income. The strong rice price increase may create suffer more on the low-income

households. Logically, a rise in the price of rice is equivalent to a drop in real income for the majority of the poor who are net consumers of rice which is rice price to income ratio increase significantly. In this context, higher prices increase the number of poor people and push people deeper into poverty and hunger, forcing them to sacrifice essentials such as more nutritious food, healthcare and children's education.

Mathematical expression of rice related restlessness ratio (R) as the ratio between the price and the per capita income is shown as Equation (1):

$$R = \frac{P}{I} \quad (1)$$

where P = Rice price (USD/Kilogram) and I = Income per capita (GNI USD per capita).

Price itself is not the measure of life burden because even though the price increases significantly over time, we do not have to worry as long as the income keeps pace with it. In other words, the increasing price will not stress people if their income also increases accordingly. So, substantially, people do not suffer from the increasing price. People suffer when they feel that their life burden is getting heavier. This happens when their income cannot fulfill their basic needs anymore. It is reflected as the inability to get rice at certain price and income level. So, the substantial problem is whether the life burden is increasing over time.

R is the measure of life burden because if the R increases significantly over time in a country, then the rice is getting hard to get in that country. In other words, the higher the R-value, the heavier the life burden. So, R must be directly proportional to the price and inversely related to income.

Rice related restlessness ratio (restlessness for short) is comparable from year to year. Two years having the same restlessness ratio exert the same burden to people expectedly. The year having greater restlessness exerts heavier burden to people than that having the lesser one.

"Burden" is a scalar quantity. "Burden" is less burdening when it approaches zero and more burdening when it leaves zero. So, burden, R = 0.1 is more burdening then R = 0.09. Maybe, we are still whistling all day when the burden, R = 0.3 because it is not burdening us. Just like "Heat" which is measured by temperature is a scalar. Heat can be cold or hot. The heat is getting colder when the temperature is going down. The heat is getting hotter when the

temperature is going up.

The life burden increases if the R increase significantly from one period to the next. The life burden is getting more burdening when R increases from 0.0001 to 0.0002 (we call it "getting more burdening" even though both R values are still low).

It should be noted that "unprecedented level" does not necessarily means high, here is the analogy:

Let's say average student-TOEFL-score is 200 in last five years with Upper Control Limit (UCL), 250 and Lower Control Limit LCL, 150. What will happen if University regulates that students must have TOEFL Score of 400 this year? The students will go unrest because 400 is the unprecedented level even though 400 is still a low score.

Unprecedented thing is the one that has never been experienced before. Something that is unprecedented is not known. We are deserved to worry about something unprecedented. If someone has never experienced a bad period then we worry about his not being able to succeed in experiencing that bad times. This also applies to restlessness. It is when R reaches unprecedented level (significance increase in life burden) that riot occurs, this is the sufficient condition for the occurrences of rice crisis.

This paper improved the R formula by changing Equation (1) to Equation (2).

$$R = \frac{P}{I} * C \quad (2)$$

It is important to note that Equation (2) added C variable where C represents the rice consumption (kg/Capita).

We added the C variable because the assumption of constant consumption per year in Equation (1) is not realistic, the population growth occurs every year. So, the consumption of rice will be different every year. If rice consumption is low then the burden of life to get the rice become low, let alone for someone who does not eat it.

In addition, Equation (2) has improved Equation (1) so that R becomes dimensionless, things not done in Equation (1). Another weakness of R in Equation (1) is that it does not measure the adequacy of income in meeting the energy needs per capita/year. As a consequence of the change in R, we have to re-assess the validity of R in Equation (2). Therefore, based on R in Equation (2) we will consider the following hypothesis:

2.1 Hypothesis

"Unprecedented restlessness is the strong indicator of rice crisis at national level".

2.1.1. Statistical Hypothesis

$H_0: \rho_g = 0$ (UR is not strong indicator for rice crisis)

$H_1: \rho_g > 0$ (UR is the strong indicator for rice crisis)

If statistics test shows significant results, then the indicator can be used to assess the effectiveness of the solutions for avoiding rice crisis in the future. This is a logical consequence of the strong nature of the indicator. If there is unprecedented restlessness then it will be followed by a crisis immediately. Conversely, if there is not then there will be no crisis.

2.1.2. Test Statistics

The previous paper, in [1] have described the hypotheses testing that unprecedented restlessness is a strong indicator of rice crisis. The paper has been used two statistic tests, rg-statistics and Q statistics. Both statistics have a weakness in showing the validity of unprecedented restlessness as a strong indicator of rice crisis. Specifically, the weakness of rg-statistics and Q-statistics is that it tends to be only valid in indicating the event of no rice crisis (strong on not unprecedented). It was not convincing in detecting the events of the crisis. So we doubt its validity in detecting crisis events. We therefore are forced to develop two new statistics to overcome the weaknesses possessed by the rg-statistics and Q statistics. The statistics are success probability and constraint probability. These two statistics have a vital role as success criteria in assessing the validity of an indicator. If an indicator is valid, it is measuring the right thing [6]. Validity is the extent to which an indicator predict a criterion, in this paper the extent to which unprecedented restlessness as an indicator under study predicts subsequent rice crisis. The statistical index of validity is the correlation or association measure between precedence event and rice crisis occurrence.

Unprecedented restlessness is stated as a rice crisis indicator if and only if it has the strong characteristic. It has strong characteristic if the presence of unprecedented restlessness event is followed by rice crisis immediately and the absence of it means no rice crisis occurs. Therefore, to gain confidence that unprecedented restlessness has good validity, then we

developed the statistics success probability and constraint probability.

Success probability is referred to unprecedented frequencies which showed the incidence of actual rice crisis. The purpose of success probability is to look at actual rice crisis event, which is unprecedented.

If the frequency of true predicted crisis events is denoted by a unprecedented guess wrong frequency is denoted by c, then the formula for the success probability is denoted by SP can be expressed mathematically as follows:

$$SP = \{a/(a+c)\} \geq 60\ \% \quad (3)$$

2.1.3. Constraint Probability

The number of crisis events correctly guessed should be enough. An educated guess should not be only one correct guess. If it guesses correctly only once then we do not believe it, the correct guesses must be at least three times. If the frequency of true predicted crisis events is denoted by a rice crisis incident guesses wrong frequency is denoted by b, then the formula for the constraint probability which denoted by CP can be expressed mathematically as follows:

$$CP = \{a/(a+b)\} \geq 60\ \% \quad (4)$$

Furthermore, a methodology is needed to perform a presidency analysis. This is achieved by identifying the occurrence of a, b and c as inputs to measure SP and CP. We have developed a methodology that is designed specifically to perform the precedence analysis. The methodology is modified I-Chart.

2.2. Modified I-Chart without Outlier Removal Procedure

The Usual Individuals Control Chart (I-Chart) value is calculated as follow:

$$\text{Center line} = \overline{X} \quad (5)$$

This line is usually plotted as a horizontal solid line

$$\text{LCL} = \overline{X} - LS$$

$$\text{UCL} = \overline{X} + LS \quad (6)$$

L is the “distance” of the control limits from the center line, expressed in standard deviation units. The common practice to determine L is by setting the coefficient of confident α. In the

Usual Individual Control Chart (I-Chart), n is fixed as the size of the subgroup. The use of Montgomery three-sigma control limits is justified on the basis that they give good results in practice [7]. The usual method I-Chart is not the appropriate statistical tool to do precedence analysis as consequence of the unprecedented concept. The main objective of accurate control chart design in precedence analysis context is to obtain strong evidence on the relationship between rice crisis occurrence and precedent restlessness event. It means that unprecedented restlessness is not an indicator if a lot of countries that experienced unprecedented restlessness were not in crisis. There are three parameters in Modified Individual control chart (MI-CHART) that will determine its accuracy, all three parameters are n = the number of observations as the length of moving average, L = the width of the control chart and i = checkpoints (time in year).

As a consequence of it, we cannot apply directly the existing I-CHART because it does not perform an integrated analysis of the interrelationship among three parameters of control (n,L,i) that produces accurate MI-CHART.

We want to obtain convincing evidence by test it massively in 43 countries as the proving ground. Based on that reason, we developed Modified I-Chart with the following algorithm:

i. The first control chart is constructed with an initial number of observations n = 4 (years)
ii. 4 data is plotted on the control chart
iii. If there are outliers, then no need to revise the control chart
iv. Do unprecedented restlessness tracking using the data on the fifth year period as check year, record the result in the check sheet
v. Unprecedented restlessness tracking is stopped until check year's data are run out
vi. Present the data of unprecedented versus crisis-no crisis facts in a contingency table.

Without outlier, removal procedure means that the data are not first cleaned of outliers. So, the outliers can also be found before check-year. We differentiate between unprecedented and outliers, outliers are points that lies before the check year while unprecedented are points at the check-year one.

3. RESULTS AND DISCUSSION

3.1. Population Criteria and Data

Based on working paper of [8], it is obtained information on the population of the countries which are having similarities with Indonesia based on three characteristics that is the democratic atmosphere, rice consumption and purchasing power of rice. We have followed the methodology of the paper and 43 countries are obtained. The list of the population and its R data are presented in https://drive.google.com/drive/folders/0B8ya6CNWBAbwVVUzaExBazZRdGc?usp=sharing.

3.2. Data Analysis

Because there are too many configurations of n, L, I which must be processed and take so much time if the process is done manually, a computer program has been developed for this purpose. The computer has processed a great number of possible configurations to find a control chart with the sufficient SP and good CP. Comprehensive results of precedence analysis for 43 countries are presented in Table 1. The details are presented at https://drive.google.com/drive/folders/0B8ya6CNWBAbwVVUzaExBazZRdGc?usp=sharing. The analysis using a computer program provides extensive search results as presented in Table 1. The Table indicates the value of the combination of n and L that is most fit with actual rice crisis events. Good results of precedence analysis for 43 countries are achieved by a combination of n = 10 and L = 3.30 as shown in Table 1. The details of the computer results are presented at https://drive.google.com/drive/folders/0B8ya6CNWBAbwVVUzaExBazZRdGc?usp=sharing.

Table 1. Unprecedented restlessness analysis result in 43 countries

Control Chart Type	: Modified Moving Average Without Outlier Removal
Std. Multiplier	: 3.20
Range Length (Years)	: 10
Unprec. To Crisis (Years)	: 2
Discr. Threshold (%)	: 60.00
Data File Name	: D:\rony\data\YUYUN\RICE\indicator\data\data_151016\R43C.xlsx
Number of Countries	: 43
Indicator Conclusion	: Strong On Not Unprecedented
Unprecedented vs Crisis	: 8 (30.77%) which is cell (a)
Unprecedented vs Not Crisis	: 18 (69.23%) which is cell (c)
Not Unprecedented vs Not Crisis	: 437 (99.65%) which is cell (d)
Not Unprecedented vs Crisis	: 6 (1.35%) which is cell (b)
Relative Discriminant	: 94.006659

The calculation of the value of Success Probability (SP) and Constraint Probability (CP) is obtained based on the result of recapitulation in contingency table 2 x 2 as shown in Table 2. The output values in Table 1 are used as inputs to calculate SP and CP as shown in Table 2

Table 2. Contingency table 2x2

	Unprecedented	**Non Unprecedented**	**Total**
Crisis event	a = 8	b = 6	$R_1 = 14$
Non crisis event	c = 18	d = 437	$R_2 = 455$
Total	$C_1 = 26$	$C_2 = 443$	N = 469

Then the value of SP and CP is calculated using the formula that has been stated previously and is obtained the value of SP and CP as follow:

$$\text{CP} = \frac{8}{14} = 0.57, \text{SP} = \frac{8}{26} = 0.31 \quad (7)$$

SP and CP values are an indication that there is a correlation between Unprecedented Restlessness as the indicator and rice crisis events. The next question is whether the value of SP and CP are significant? The determination of the significance of SP and CP is done by using risk analysis approach. This is a different approach from the usual approach, i.e. by setting a threshold number e.g. 60%, 70% or even 90% subjectively.

4. CONCLUSION

Using Modified I-Chart Without outlier removal procedure, the combination of values of n = 10 and L = 3.20 result success probability of 0.31 and constraint probability of 0.57.

We have a fact 31% validity of unprecedented restlessness in indicating rice crisis. What can we conclude? How to interpret the results of SP and CP above? Is it enough if SP and CP exceed the number 0.5? It must be recognized that not all events with a probability below 50% are not believed or not all event probabilities above 50% must be trusted. It may be for a particular event probability of 70% is too low.

In this context, we would like to propose calculated risk approach than the establishment of a number of subjective bases, 50%, 60% and so on. This means all must be considered from risk calculation.

How is risk analysis done? This will be the next research. We must calculate the costs of wrong decision because of believing it and not believing it. If risk losses due to believing in 31% success probability is greater than risk losses due to not believe then choose not believe in it. So in this paper, we recommend a new approach in determining the success criteria of an indicator. Usually, the success criterion is determined by a number, say 0.5 that indicates exceeding the event by chance. So in this paper, a new approach is introduced in determining the success criteria of an indicator. Usually, the success criterion is determined by a number, say 0.5 which indicates an exceedance of a chance event. In our research framework, the success criteria of an indicator are stated on the basis of risk analysis.

6. ACKNOWLEDGEMENTS

We would like to thank the financial support from Universitas Padjadjaran through the grant program of Fundamental Research of Unpad Lecturer (*Riset Fundamental Dosen Unpad*/ RFU).

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How to cite this article:
Hidayat Y, Purwandari T, Sukono, Supian S, Juahir H, Kamarudin MKA, Ireana Yusra AF. Improving unprecedented restlessness as the new strong indicator of rice crisis at national level. J. Fundam. Appl. Sci., 2018, *10(1S), 128-138.*