academicJournals

Vol. 9(1), pp. 74-79, 2 January, 2014
DOI: 10.5897/AJAR11.429
ISSN 1991-637X ©2014 Academic Journals
http://www.academicjournals.org/AJAR

African Journal of Agricultural Research

Full Length Research Paper

Wheat production price performance prediction in the Iranian north province

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Accepted 4 December, 2013

Wheat is a cereal grain, originally from the Levant region of the Near East and Ethiopian Highlands, but now cultivated worldwide. Wheat was a key factor enabling the emergence of city-based societies at the start of civilization because it was one of the first crops that could be easily cultivated on a large scale, and had the additional advantage of yielding a harvest that provides long-term storage of food. The purpose of this paper is to review increase or decrease effects of the wheat production price from the on farm to the retail, and then analyze the transmission mode of price fluctuations in the wheat market. The original research uses the weekly price wheat from December 2009 to December 2012 in the Iranian north province stock market. It applied the fuzzy cognitive map (FCM) method for prediction of price transmission performance in the wheat production; the results of this study indicate that the price transfer from wholesale to retail to be done asymmetrical. This study contributes to research on transmission of the wheat price from the on farm to retail market.

Key words: Causality test, wheat production, fuzzy cognitive map (FCM), Iranian north province.

INTRODUCTION

Wheat is a cereal grain, originally from the Levant region of the Near East and Ethiopian Highlands, but now cultivated worldwide. In 2010, world production of wheat was 651 million tons, making it the third most-produced cereal after maize (844 million tons) and rice (672 million tons). Wheat was the second most-produced cereal in 2009; world production in that year was 682 million tons, after maize (817 million tons), and with rice as a close third (679 million tons). This grain is grown on more land area than any other commercial food. World trade in wheat is greater than for all other crops combined. Globally, wheat is the leading source of vegetable protein in human food, having a higher protein content than other major cereals, maize (corn) or rice. In terms of total production tonnages used for food, it is currently second to rice as the main human food crop and ahead of maize, after allowing for maize's more extensive use in animal feeds (Aguiar and Santana, 2002). Wheat was a key factor enabling the emergence of city-based societies at the start of civilization because it was one of the first crops that could be easily cultivated on a large scale, and had the additional advantage of yielding a harvest that provides long-term storage of food. Wheat contributed to the emergence of city-states in the Fertile Crescent, including the Babylonian and Assyrian empires. Wheat grain is a staple food used to make flour for leavened, flat and steamed breads, biscuits, cookies, cakes, breakfast cereal, pasta, noodles, couscous and for fermentation to make beer, other alcoholic beverages, or biofuel (Rapsomanikis et al., 2003).

Campa and Goldberg (2005) examined how to move price transfer from the on farm to retail for four dairy products: butter, cheese, raw milk, and ice cream in the United States. The results showed that increase in farm

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prices facilitates a more complete transfer of products to retail level, than when there is decrease in farm prices; thus, price transmission has been made asymmetric. Ghosh and Rajan (2006) showed that, prices of the dairyproducts in the Brazil processing industries is transferred from the farm to retail faster than from retail to the farm. Schnepf (2008) came to the conclusion that, the price transfer of beef and pork is asymmetric. Mundlak and Larson (1992) to review symmetry price test for the product of raw milk and the 2% fat milk in 7 U.S. states, their results was being as evidence of price asymmetric transmission. Von (2008) came to the conclusion that, reducing prices over the on farm is transmitted faster and more complete in the price transfer of fresh vegetables.

As described by the World Bank (2009) report, each policy is expected to have different effects on various groups of households and could depress incentives to farmers to increase output resulting in further increases in food prices. On the other hand, policy such as export bans or high export tariffs taken by the exporter partners may create harmful effects on Iran as a net food importer. As stated by Alizadeh (2003), the preferred rate was applied to import of essential goods, a fixed or ‘‘export” rate (3000 Rial for $1) was applied to capital goods imports of public enterprises and a variable market rate was devoted to other imports. Such a multi exchange rate system had generated implicit subsidies for state owned enterprises and revolutionary foundations as well as for importers of basic commodities. Moghadasi and Fazeli (2007) studied the market price in the dates and the pistachios. FAO (2008) was reviewed price transmission model of Iranian pistachio in global market. Recent months, Wheat production in the Iran has witnessed extreme fluctuations in price. The main cause of price fluctuations is related to seasonal and production fluctuations of this product. Production fluctuations were due to bad climatic conditions in the Asia (such as was Thailand, Pakistan, and Iran). Government intervention in the Wheat market is the main other factor that influences on the price of agricultural products. It happens often by determination of the price floor to protect producers and sometimes by providing various inputs to producer for reduction of the consumer prices.

Marketing margins is one of the major issues facing most of the markets. It is very important in agricultural products. Since the production in agriculture has many types of risk, therefore producers in agriculture section have more pressures in terms of physical and psychological, so marketing margins on agricultural products is important (Margarido and Lima, 2009). There is the difference between producer and consumer price, that this difference is the marketing margins, because of marketing services. When increase or decrease the price of producer prices has not effect on the consumers' price, marketing margin will be great importance; this type of price transmission is asymmetric transfer. Hans explains two types of asymmetric transfer, Short-term and long-term, Asymmetry in the long term means that intermediaries increase market margins fully stable while short-term asymmetry has a temporary effect on the market margins. The FCM together with genetic algorithm based learning mechanisms have been used for analysis and prediction of performance time series. The results gained are comparable with other fuzzy set based modern methods of predicting.

METHODOLOGY

It was decided to adopt a case study approach for this paper as there is little existing research on reviewing of price transmission performance. It has been based on the descriptive Research. This descriptive type research has been carried out using the questionnaire as the research tool for gathering the required data. Data gathering involved both reference material and a questionnaire survey. Sampling was simple random sampling and the data gathering instrument was the questionnaire. The author had already undertaken research in this field which had stimulated the measurement tools and the theoretical framework used to analyze this case study, based on fuzzy cognitive map method. It has been used the retail price (Pr) and On Farm prices (Pf) of Wheat a week over a period of 3 years.

The statistics has been prepared from the Central Bank of Islamic Republic of Iran. To investigate symmetric or asymmetric in the positive and negative shocks transfer of price between two levels of market, it uses the equity hypothesis test of variable coefficients. Coefficients α1, α2 are respectively increasing and decreasing effect farm prices on the retail prices. Whereas α1 with α2 are equal and both are positive, then price transfer is as symmetrical and otherwise to be asymmetrical. In order to test rejection or acceptance of null hypothesis is used the Wald test. Predicting the time series for recognizing the numerical or explanatory levels is a new approach.

This approach has been presented using the FCM together with a learning method enjoying the advantage of the real-coded genetic algorithm. In FCM framework, the systems are described through their reciprocal concepts and relationships (Song et al., 2010, Eshghi and Nematian, 2009). The suggested prediction method combines the FCM with the fuzzy set grain model, one of the advantages of which being the modeling and predicting in two numerical and explanatory levels. Comprehensive activities have been performed in mind considering two main goals. First, estimating the quality of the suggested structure and second, testing the effects of the prediction technique parameters on the prediction quality.

The gained results in comparison with other fuzzy based prediction techniques show that the suggested structure produces higher accuracy in numerical and explanatory levels (Fazel et al., 2008; Frost et al., 2010; Frey and Manera, 2007). The main aims, and in other words, the motive of selecting the FCM are as follows: Application of the FCM for predicting the time series: The motive for using this specific technique is a result of its simple and comprehensive structure, consisting of the reciprocal relationship concepts, conforming to a given range. The FCM are capable of acquiring the behavior of a given dynamic system. Recently the introduced genetic optimization based learning algorithm (genetic algorithm) allows for automatic expanding of the FCM from the genetic data.

This learning approach is flexible considering the input data. For example, both observations in successful time points of t and t+1 can be used for learning the map, and if some observations are removed from the historical data, all the remained couples still can be successfully used for learning (Frost et al., 2010). The possibility of design and expanding the absolute predicting systems, based on

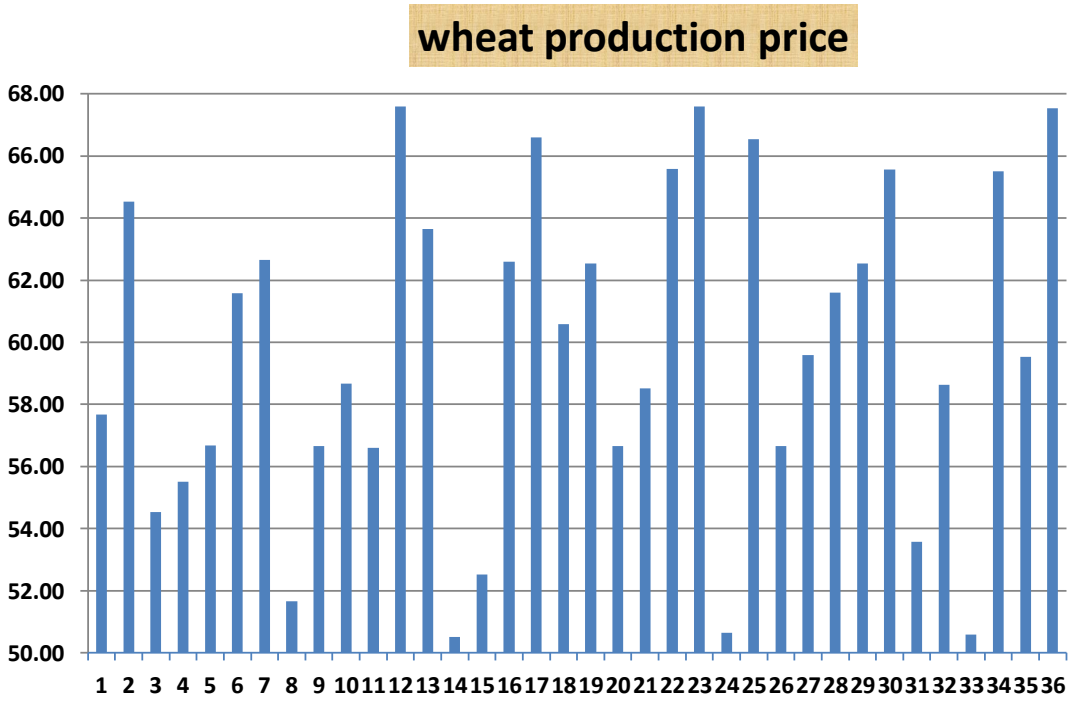

Figure 1. Price transmission performance prediction in 36 month in future.

the FCM which are capable of predicting in two numerical and explanatory levels (Eshghi and Nematian, 2009).

The FCM prediction system realizes a series of well-delineated steps. The input signal is preprocessed in a preprocessing module, which plays a dual role. First, it extracts feature(s) of interest for the linguistic prediction. They include change of signal, which is defined as a difference between two consecutive values of a given input signal, and the signal's amplitude. The change constitutes an additional time series. Second, both signals are normalized linearly to the unit interval. In order to avoid artificial enlargements of small signal changes, the normalization of change signal is carried out based on the range of the original time-series signal. More specifically, the maximum possible change value is determined and the normalization is performed with respect to this value. As a result, from the preprocessing module, two normalized signals, that is, input and change, are obtained. The first value of input signal is dismissed to have equal length of both signals.After preprocessing, information granules of the signal determining its current status are extracted and linked in fuzzification module. This process involves linguistic descriptors (labels), which are given as a set of fuzzy sets. Based on their definitions, membership values are calculated for each value of both signals. The linguistic descriptors can be defined uniformly or independently for each signal. Consider K time series as an input to this module and number of corresponding linguistic descriptors denoted by the N1, N2,…,Nk . In the first phase, these signals are represented in terms of membership values of given fuzzy sets, which results in having N1+ N2 + …+ Nk fuzzy time series. Next is the granularization process which takes place, and this links fuzzy time series with the use of fuzzy operators. Each of these time series expresses the level the given signal can be characterized by corresponding linguistic descriptors. We provide unique linguistic labels over the entire time series by choosing the descriptors with the highest values at each time point. The presence of the next, data divider, module is caused by organization of our experimental setup, and thus, it does not belong to the proposed prediction method per se. In particular, it serves for experimental evaluation of the prediction method dividing the input data set into training and test subsets. The former subset is used to develop appropriate FCM, whereas, the latter one is separate and is used to test prediction accuracy on unseen data. The actual learning of FCM is performed in the Real Coded Genetic Algprithm module, which establishes FCM based on training data. This process exploits the genetic learning algorithm, which is described in Section II.

Number of nodes in candidate FCM corresponds to number of granular time series from the output of fuzzification module. The nodes depict complete signal description within the assumed fuzzy domain, that is, each node corresponds to a single combination of linguistic descriptors of granular time series. We emphasize that, all FCM's parameters that define the model are established automatically, that is, without any substantial intervention of a model's designer. A fully developed FCM is used by linguistic prediction module to carry out the signal prediction in fuzzy domain (linguistic prediction) on the test data. This process involves a model simulation according to scenario defined in data divider module. Linguistic prediction uses fuzzy operations on granular time series obtained from simulation. Numerical prediction requires fuzzy values to be defuzzified.

Defuzzification module performs this process according to a predefined defuzzification method on granular time series, which is obtained from simulation and then is carried out on the test data. The numerical prediction is performed based on the defuzzified values. In addition to defuzzified signal value, other signal features defined in preprocessing module may be also used as a supplement, or correction coefficient during prediction.

RESULTS AND DISCUSSION

It predicts price transmission performance using FCM method; Figures 1, 2 and Table 1 presents wheat production price in 36 month in future. The average value

Table 1. Wheat production price.

Month	Prediction quantity				
1	57.67				
2	64.53	58.91			
3	54.54		58.42		
4	55.5				
5	56.67	57.92		57.94	
6	61.58				58.69
7	62.65				
8	51.67	56.99			
9	56.65		58.973333		
10	58.67				
11	56.61	60.96			
12	67.59				
13	63.64				
14	50.51	55.56		59.93	
15	52.52		59.41		
16	62.6				
17	66.6	63.26			
18	60.59				59.83
19	62.54				
20	56.66	59.24			
21	58.51		60.255		
22	65.58				
23	67.6	61.27		60.48	
24	50.64				
25	66.54				
26	56.66	60.93			
27	59.59		62.081667		
28	61.6				
29	62.53	63.23			
30	65.57				60.654
31	53.57				
32	58.64	54.27		60.56	
33	50.59		59.226667		
34	65.5				
35	59.53	64.19			
36	67.53				

of price transmission' performance in the past and future 36 month is equal to 50 and 68%, respectively. The mean square error reached to its minimum value using the above function: 0.034 and the R2 value reached to 89.23% which indicates the model validity. The *Cronbach's alpha* value is 83%, confirming the validity of the model.

The results gained from the suggested method in comparison with the results of the other methods showed that, the prediction methods based on the existing fuzzy sets have been tested only on one or two data sets. As can be seen from the results, the FCM method incurs the minimum error possible. The second better method, that is, the Fuzzy time method gained the score 0.145. The other methods including the Sung-Chissem, Chen, Markove and Hwang methods achieved the next ranks (Table 2).

Conclusions

One of problems in agricultural markets is lack of appropriate tools for economic managers' decisions. In this paper, it is discussed analyzing of patterns and efficiency model of Wheat market to model of price transmission, marketing margins, causality relationship

Table 2. Comparison of methods based on error.

Approach	Error (%)
Song - Chissom method	0.142
Chen's method	0.267
Markov method	0.457
Hwang method	0.213
Fuzzy time series method	0.176
proposed method	0.145

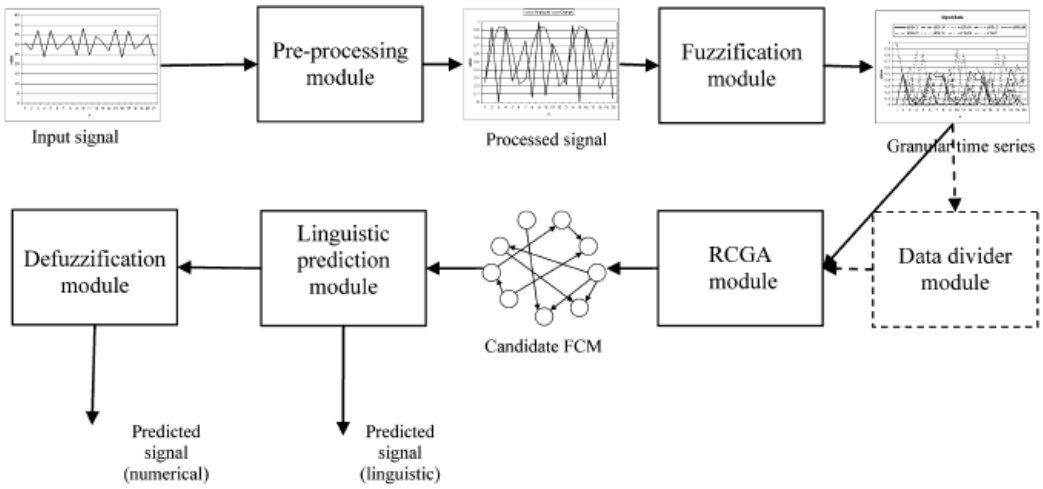

Figure 2. Price transmission performance.

between different markets. The suggested method was tested in Wheat market, Iran. The validity of the model was tested based on the Face Validity approach and other statistical analysis methods. Also it was compared with other predictive methods like Song- Chissem, Chen, and Markove methods. The results of this comparison showed that our method is the most suitable method for prediction; in other words, it entails the least errors possible.

One possible follow-up is the comparison of the proposed method with other models, such as Markov-Chain methods.

ACKNOWLEDGEMENT

This work was supported by a grant from Islamic Azad University, Zanjan Branch, Tehran, Iran.

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