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LETTER TO THE EDITOR

The Fluctuation Relationship between Spot Price and Futures Price of Agricultural Products Based on Computational Ecology

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He Yang, Kefei Liu, "A Study on Place Branding Strategy of Characteristic Agricultural Products in Xinjiang Based on Brand Ecosystem" on Issue 106, Pages: 1021-1028, Article No: e106191, in the article, The spot price of agricultural products is predicted by Q-RBF neural network optimization model, and the spot price of agricultural products and futures price are analyzed by regression analysis. The results show that there is a cointegration relationship and long-term equilibrium relationship between futures prices and spot prices, and the futures price of agricultural products is an unbiased estimate of spot prices. When the error correction item of the spot price of agricultural products is negative, the next futures price of agricultural product rises and the spot price decreases.

I Introduction

As a commodity with the highest degree of marketization and internationalization in China, agricultural product has an important position in the national economy (An et al. 2014). In recent years, the price of agricultural products has shown a general trend of rising and frequent fluctuations, the influence of its volatility is rapid, wide and complex, and the stable agricultural economy is impacted. Therefore, it is of great significance for the development of the national economy to effectively predict the spot price of agricultural products, and to analyze the fluctuation relationship between the spot price and the futures price of agricultural products, which is beneficial to the agricultural operators to obtain the best benefit and to ensure the stability of the residents' lives (Delgado Rodriguez et al. 2018, Liu et al. 2017, Pavelka et al. 2016).

Sun et al. studied the correlation between spot price and futures price of agricultural products (Sun and Wang 2015); Shi et al. used the improved RBF neural network to predict soybean prices in China (Shi et al. 2016).

According to the test results, the fluctuation relationship between the spot price and the futures price of agricultural products is analyzed, which provides the theoretical basis for the government to formulate relevant policies on agricultural products, and provides theoretical guidance for the producers and operators of agricultural products.

II Empirical analysis

The dimension n1 in the neural network model based on Q-RBF is the integer in the range of (Li et al. 2014); The delay order of historical data is determined empirically. In this paper, we take the historical data with delayed one order (q = 1) as the fixed input of the model. The initial value of the radial basis function center C is; the initial value range of the extended constant σ is. The initial value range of the output layer weight W is. In addition to q as a definite value, the factors affecting factor dimension n1, the number of hidden layer nodes m, radial basis function center C, extension constant σ, and output layer weight W need to be further optimized through the algorithm. In addition, the gradient descending step length is 0.0015 and the number of operations are three times; the initial population size of GA is 80, the cross probability is 0.9, the mutation probability is 0.1, the iteration number is 150 times, and the error requirements E (τ) is 0.03.

The Q-RBF neural network model after training is used to predict the spot price of domestic agricultural products (test set samples) in 2015 (Li and Zhao 2017). The prediction results based on the Q-RBF neural network model are shown in Table 1 According to Table 1, the absolute value of relative error of all months is less than 1.8%, and the average relative error MAPE is 1.11%, which indicates that the prediction accuracy based on Q-RBF neural network model is high. That the neural network model based on Q-RBF has good extrapolation performance and strong generalization ability.

Table 1. Prediction results based on Q-RBF neural network model

Result		Real value/yuan	Predictive value/element	Relative error/%	Average relative error/%
Time/year.month	2015.5	3990	4011	0.53	1.11
	2015.6	4030	3998	-0.79	
	2015.7	4015	3964	-1.27	
	2015.8	4130	4056	-1.79	
	2015.9	4204	4180	-0.57	
	2015.10	4056	4122	1.63	
	2015.11	3759	3701	-1.54	
	2015.12	3800	3772	-0.74	

In order to investigate the performance of the improved algorithm, the prediction accuracy and convergence efficiency of the Q-RBF neural network model before and after the algorithm improvement are compared. Is called the improved algorithm for short. The prediction values, prediction errors and convergence efficiency of the two algorithms are shown in Table 2 and Table 3 respectively. As shown in Table 2, the absolute value of the maximum relative error and average relative error of the improved algorithm are 1.79% and 1.11% respectively, which are better than 3.17% and 1.77% before the improvement. The results show that the Q-RBF neural network model based on GA and gradient descent algorithm has better prediction effect. In Table 3, the fixed error is given, and the number of final iterations before and after the algorithm is improved. Therefore, it can be considered that the gradient descent method is used to solve the problem at the beginning stage, and the parameter after the iteration with a certain number of times is used as the initial value of the genetic algorithm, which can accelerate the convergence efficiency of the model optimization.

Table 2. Prediction value and prediction error before and after improved algorithm

Method			GA		The improved algorithm	
		Real value /yuan	Predictive value/element	Relative error /%	Predictive value/element	Relative error /%
Time/year.month	2015.5	3990	3952	-0.95	4011	0.53
	2015.6	4030	3994	-0.89	3998	-0.79
	2015.7	4015	3968	-1.17	3964	-1.27
	2015.8	4130	3999	-3.17	4056	-1.79
	2015.9	4204	4109	-2.26	4180	-0.57
	2015.10	4056	4090	0.84	4122	1.63
	2015.11	3759	3890	3.48	3701	-1.54
	2015.12	3800	3746	-1.42	3772	-0.74
	MAPE	1.77			1.11	

Table 3. Comparison of convergence efficiency before and after improved algorithm

Test times	τ	Algebra to satisfy the error	
		GA	Improved algorithm
1	0.1	21	16
	0.3	250	128
	0.6	282	260
	0.9	25	18
2	0.1	13	24
	0.3	277	131
	0.6	N	95
	0.9	9	13
3	0.1	13	16
	0.3	N	113
	0.6	297	81
	0.9	6	9
4	0.1	17	15
	0.3	288	153
	0.6	153	80
	0.9	18	15
5	0.1	24	20
	0.3	103	N
	0.6	238	35
	0.9	19	16

III Discussion

According to the asymmetry and nonlinear characteristics of the spot prices and futures prices of domestic agricultural products, the Q-RBF neural network optimization model of computational ecology is used to predict the spot price of agricultural products. The model consists of two parts: the outer frame of the model is quantile regression structure, and the internal core is RBF neural network structure. At the same time, a hybrid algorithm of gradient descent algorithm and GA is proposed to optimize the structure and parameters of the model synchronously. The results of spot price prediction of domestic agricultural products verify the effectiveness of the Q-RBF neural network optimization model and algorithm. The model has obvious advantages in the two aspects of prediction accuracy and convergence efficiency. It is a prediction model that can be widely used.

According to the prediction result of the spot price of agricultural products by Q-RBF neural network optimization model, the fluctuation relationship between futures price and spot price is analyzed. The stability of the difference is more significant, and there is a long-term dynamic equilibrium relationship between the futures price and the spot price of agricultural products. By further analysis of Grainger causality test, it is found that the futures price of agricultural products has a guiding role on the spot price, while the spot price is not sensitive to the futures price, the lag effect is not too obvious, and the spot price of agricultural products does not have the guiding role on the futures price. This shows that the futures price of agricultural products does not cause and expand the fluctuation of spot prices,

The futures market is the most concentrated place for the supply and demand information of the agricultural products market, which brings together the information issued by all investors and forecast experts. However, the futures market of agricultural products will also be affected by non-market factors, resulting in the price deviation of agricultural products from the equilibrium state of the market. we should strengthen the management of the futures market of agricultural products, establish and perfect the trading rules of the futures of agricultural products, improve the standardization of the operation of the futures market, ensure the efficiency of the operation of the agricultural products market, avoid and reduce the behavior of the malicious speculation of a small number of bankers, so that the price can accurately reflect the supply and demand of agricultural products, According to the futures market theory, the more conducive to the decentralization of market risks is, the stronger the competitiveness of the market is, and the more fully the pricing mechanism formed is, making the operators more conducive to adjusting production operations. Making the operators more conducive to the adjustment of production and management. Therefore, on the basis of the existing agricultural futures market, we should further increase the variety and scale of the futures trading of agricultural products, actively guide the operators of agricultural products to participate in futures trading, especially to improve the enthusiasm of farmers to participate in the futures market, and expand the scale of the futures market. This will help to diversify the market risk of agricultural products, stabilize the prices of agricultural products and promote the structural adjustment of agricultural production.

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