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RESEARCH ARTICLE

Using Quantile Regression Approach to Analyze Price Movements of Agricultural Products in China

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Abstract

This paper studies how the price movements of pork, chicken and egg respond to those of related cost factors in short terms in Chinese market. We employ a linear quantile approach not only to explore potential data heteroscedasticity but also to generate confidence bands for the purpose of price stability study. We then evaluate our models by comparing the prediction intervals generated from the quantile regression models with in-sample and out-of-sample forecasts. Using monthly data from January 2000 to October 2010, we observed these findings: (i) the price changes of cost factors asymmetrically and unequally influence those of the livestock across different quantiles; (ii) the performance of our models is robust and consistent for both in-sample and out-of-sample forecasts; (iii) the confidence intervals generated from 0.05th and 0.95th quantile regression models are good methods to forecast livestock price fluctuation.

Key words: cost factors, agricultural products, forecasting, price movements, quantile regression model

INTRODUCTION

Since 1949 the Chinese agricultural products market has experienced three stages such as a planned economy, the coexistence of the planned economy and a market-oriented economy, and the transition from the planned economy to the market-oriented economy. In a perfectly market-oriented economy, the type and amount of agricultural products produced by farmers are jointly determined with market price signals. However, in the current Chinese agriculture industry, the lack of advisable market information analysis makes it difficult for Chinese farmers to form sensible prior decision. Consequently, it is not surprising to see a roller-coaster kind of price movements of agriculture products repeating in recent years, which has severely distorted the agriculture industry and incurred significant loss of consumer welfare in China, and the current high-inflation environment makes the situation even worse. Understanding the price spillover effects from one agriculture product to another one becomes prerequisite for policymakers to lay down any price control policy in agricultural product markets and subsidy policy in consumer consumption.

Therefore, this paper tends to study the price influence factors of four commonly consumed agriculture products such as pork, chicken, egg, and milk. Specifically, we investigate how the changes of livestock feed prices spread to the price movements of

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these four agriculture food products in short terms.

Traditional regression analysis focuses on conditional mean function m (x) that has been applied widely in the social sciences. Generally conditional mean model summarizes the relationship between one or more covariate X and the conditional mean of a response variable Y given X=x (Yu and Jones 1998). Under ideal conditions, the approach can provide a complete and parsimonious description of the relationship between the independent variables and the dependant variable. However, the conditional mean regression model has some limitations (Hao and Naiman 2007). First, it can not be readily extended to tail locations where social science research is often of interest. Second, the conditional mean model is heavily influenced by outliers. Nevertheless, heavy-tailed distributions often occur in the real world. Third, this approach easily steers attention away from the properties of the whole distribution of the response variable that is how changes in the independent variables affect the shape of response variable distribution.

There is an alternative to conditional mean model. The quantile regression model was introduced by Koenker and Bassett (1978), which models the relationship between predictor X and the conditional quantiles of Y given X=x. The linear quantile regression model complements the linear mean regression model if the error terms in the mean regression model are heteroscedastic. Therefore, by examining the results estimated from both the quantile and mean regression models, we are able to explore more useful information from the data. One important application of a quantile regeression method is to construct 95% confidence intervals for fitted dependent variables or forecast values.

Recent 10 yr there is a rapidly expanding empirical quantile regression literature in economics such as forecasting, consumption, education, risk evaluation, finance, etc. In forecasting application, Taylor and Bunn (1999) used quantile regression approach to generate prediction intervals and results indicated this method was useful for various forecasting applications. Koenker and Hallock (2001) used quantile regression to analyze the relationship between household food expenditure and household income and the results revealed that the conditional distribution of food expenditure was skewed to the left. Matthys *et al*. (2004) presentd an extreme quantile estimator for heavy-tailed distributions. Gustavsen and Rickertsen (2006) used censored quantile regression to analyze vegetable demand. Taylor (2007) used exponentially weighted quantile regression to construct interval forecasts for daily supermarket sales and results showed it was better than point forecasting by traditional methods. Cai (2007) fitted a quantile self-exciting threshold autoregressive time series model to forecast the growth rate of US GNP and the results showed that the method worked very well in practice. Clements *et al*. (2008) used this method to forecast daily exchange rate returns. Ma and Pohlman (2008) showed that under mild conditions quantile regression approach could provide more accurate forecasts and potentially higher value-added portfolios than classical conditional mean model. In consumption study, Koenker and Hallock (2001) used quantile regression to analyze the relationship between household food expenditure and household income. Chen *et al*. (2008, 2009) employ quantile regression to analyze Chinese resident's consumption. Chen *et al*. (2009) use local quantile regressions to analyze relations between health care expenditure and income. In risk evaluation, Wu and Ma (2006) introduce quantile regression method to estimate extreme behaviour models. Banachewicz and Lucas (2008) employed quantile forecasting for credit risk management. Li (2010) re-examined the risk return relationship in the banking industry using quantile regression. In education fields, Liu (2008) uses quantile regression and censored quantile regression to analyze influences of education and experience on Chinese residents. In finance study, Lai and Lai (2008) use quantile regression to explain the determinants of capital structure. Li and Dong (2008) employs quantile regression to analyze relationship between volatility and trading volume of Chinese stock market. Findings from existing literature, most studies on agricultural products market forecasts are involved in conditional mean regression model (Ma *et al.* 2007; Li 2010; Xie 2010), time series model (Fu *et al*. 2008; Liu and Li 2009; Dong *et al*. 2010), artificial neural network (Wang 2008; Ping *et al*. 2010), etc. Typically, the accuracy of these methods could reach more than 80% when we employed them to forecast short term market price. However, the results are not very satisfactory when extreme conditions occur. In addition, the point forecasting is difficult to ensure accurate prediction when the uncertainty of future situation increases, especially for agricultural products.