International Journal of Agricultural Management & Developement (IJAMAD)
Available online on: www.ijamad.com

Forecasting Iran's Rice Imports Trend During 2009-2013

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Received: 12 December 2010,
Revised: 28 February 2011,
Accepted: 4 March 2011.

Abstract

In the present study Iran's rice imports trend is forecasted, using artificial neural networks and econometric methods, during 2009 to 2013, and their results are compared. The results showed that feet forward neural network leading with less forecast error and had better performance in comparison to econometric techniques and also, other methods of neural networks, such as Recurrent networks and Multilayer perceptron networks. Moreover, the results showed that the amount of rice import has ascending growth rate in 2009-2013 and maximum growth occurs in 2009-2010 years, which was equal to 25.72 percent. Increasing rice import caused a lot of exchange to exit out of the country and also, irreparable damage in domestic production, both in terms of price and quantity. Considering mentioned conditions, economic policy makers should seek ways to reduce increasing trend of rice import; and more investment and planning for domestic rice producers.

Keywords:
Income distribution, Rice-based farmers,Gini coefficient, Sustainable.

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INTRODUCTION

Rice is considered as the one of the most important cereal in human consumption (Kazemnejhad & Mehrabi Boshrabadi, 1999, p. 104). Among cereals, rice is the only product that is grown for human consumption. Rice, after wheat, is the second most consumed crop in Iran that its use has been increased since 50s, significantly (Noori, 2002, p. 27). At present, Iran is considered as one of the major importers of rice. During 2008, nearly 1383 thousand tons of rice, worth 790 million dollars, was import to the country that compared to last year, was increased about 30 percents, in term of weight, and 85 percents, in term of value. Thus, proper policies are necessary to reduce import and increase domestic production of rice, that this would not be possible regardless of the future status of the country's imports. Today, the importance of economic variables forecasting is obvious for economic programmers and policy makers. Therefore, in the recent decades, various models of forecasting were developed and also competed with each other. In fact, in order to evaluate the efficiency of this model, the accuracy of their predictions should be compared. Thus, a model will be successful in explaining the relationship between variables if it is able to forecast the future values of variables accurately. In the past, economists were trying to explain the current situation and forecasting the future values of dependent variables as well as providing economic policies, by using various econometric methods. In mid 90s, these important deficiencies and importance of forecasting major economic variables led to use models which named artificial neural network in order to increase the accuracy of their predictions to in compare with other models. Considering the mentioned points about importance of economical variables forecasting, in this study, neural network model is used to forecast the amount of Iran's rice import. Application of neural networks in economy began by studying white (1988) who forecasting IBM corporation stock price in financial markets, in the late 80s. Portugal (1995), in a study titled "Neural networks versus time series models", these two methods are used to forecast the rate of industrial production in Brazil. Church and Curram (1996) showed that the neural network didn't present more accurate results of linear models to forecast macroeconomic variables. Adnan and Nadeem (2007) emphasized on accurate results of ANN for economic variables forecasting. Tkcaz (2001) predicted Canadian GDP growth using neural network. Results of this study indicated that neural networks yield statistically lower forecast errors for the year-over-year growth rate of real GDP relative to linear and univariate models. However, such forecast improvements are less notable when forecasting quarterly real GDP growth. Haider and Hanif (2007) compared the forecast performance of the ANN model with conventional univariate time series forecasting models such as AR(1) and ARIMA based models and observed that RMSE of ANN based forecasts is much less than the RMSE of forecasts based on AR(1) and ARIMA models. At least by this criterion forecast based on ANN are more precise in forecasting of inflation in Pakistan. Faria & et. al (2009) used artificial neural networks and the adaptive exponential smoothing method in forecasting of principal index of the Brazilian stock market. This study showed that both methods produce similar results regarding the prediction of the index returns. On the contrary, the neural networks outperform the adaptive exponential smoothing method in the forecasting of the market movement, with relative hit rates similar to the ones found in other developed markets. Chu and Zhang (2003) compared linear and nonlinear models results in forecast of aggregate retail sales. Findings of this article showed that, nonlinear models are able to outperform their linear counterparts in out of sample forecasting, and prior seasonal adjustment of the data can significantly improve forecasting performance of the neural network model. The overall best model is the neural network built on deseasonalized time series data. While seasonal dummy variables can be useful in developing effective regression models for predicting retail sales. In the present study, the amount of rice import has been predicted by using the ARIMA and neural network methods in 2009-2013. The requested data set had been collected from the I.R. Iran's Central Bank.

MATERIALS AND METHOD

ARIMA model

According to Box and Jenkins (1976), an economic variable, say X has a generating function which belongs to a class of Autoregressive Moving Average models (ARIMA) which can be represented as: (1)

$$Ø_p(\beta)(1-\beta)^d(X_t)= \Theta_q(\beta)e_t \quad (1)$$

Where β is lag operator such that $\beta_j X_t = X_{t-j}$, $Ø_p$ is autoregressive parameter of order p, Θ is moving average parameter of order q, d is the number of integration order (usually 0, 1, or 2) that Xt need to be differenced to achieve stationarities.

Compared to spectral methods, Box-Jenkins forecasting approach involves an interactive process between the forecaster and the data in terms of using diagnostic statistics to select the appropriate models. In addition, the Box-Jenkins approach requires less data and has generally proved successful in empirical cases.

Artificial Neural Network

Neural network are Computational models which are capable of determining the relationship between inputs and outputs of a physical system by a network of nodes that are connected all together. In this network, nodes located in consecutive layers and their relationship is unilateral. When an input pattern is imposed to the network, the first layer calculates its output value and provides it for the next layer. The next layer received these values as input; and move output values to the next layers, and each node transmits signals just to the nodes of next layer (Heravi & et. al, 2004). Two learning methods are used, supervision and unsupervision, in training neural network. General form of neural network is shown in Figure (1). Input neurons are known as independent variable and output neurons as dependent variable.

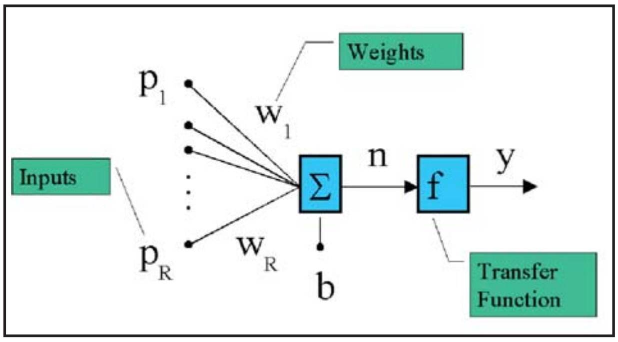

Figure1: General model of neuron

In general, the role of neurons is processing information, in the neural network; this action is done by a mathematical process which is known as the activation function, in artificial neural networks. An activation function is chosen by planner according to the need of particular issue. Input must be standardized in order to prevent to lessen weights in Neural Networks, excessively (Haykin, 1994). For this study, the following equation is used to standardize data. (2)

$$N_i = 0/8 \times [\frac{X_i - X_{min}}{X_{max} - X_{min}}] + 0/1 \quad (2)$$

Table1: Different criteria for comparison of forecasting

Criteria		Formula
Mean Squared Error	(MSE)	$MSE = \frac{\sum(\hat{y}_t - y_t)^2}{n}$
Root Mean Square Error	(RMSE)	$RMSE = \sqrt{\frac{\sum(\hat{y}_t - y_t)^2}{n}}$
Mean Absolute Deviation	(MAD)	$MAD = \frac{\sum\lvert\hat{y}_t - y_t\rvert}{n}$
Mean Absolute Percentage Error	(MAPE)	$MAPE = \frac{\sum\lvert\frac{\hat{y}_t - y_t}{y_t}\rvert}{n}$

Where N_i represents Standardized values, X_i actual values, X_{max} maximum actual values. The above equation standardizes inputs from 0.1 to 0.9. After completing the steps of forecasting and obtaining values, the following indices could be used in order to compare the power of forecasting and select the best method. In this study, the indices of RMSE, MSE and MAPE were used.

In Table 1 $\hat{y}_t$, y_t and *n* represent forecasted value, actual value and number of time periods, respectively.

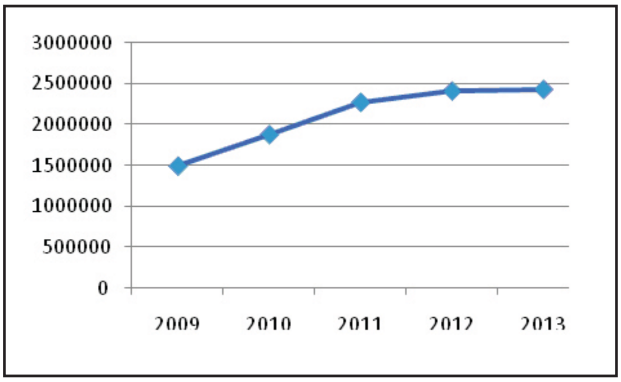

Figure 2: Forecasting of rice import by using neural network during 2009-2013

RESULTS

Before training and testing network, data were normalized based on mentioned statistical methods. For designing network, training and experimental data were considered during 1961-2001 and 2002-2008, respectively. In this study, several types of networks were tested for forecasting value of rice import. Finally, feet-forward neural network was used. Also for the design of network, software box artificial neural network in Matlab7 environment was used. Among the different architectures for design network, Architecture of 1-1-2-5 consists of two layers. The first and last layers have 2 and 1 neurons, respectively, and 1 is indicator of output; and was chosen as the best architecture due to high R^2.

Figure (2) shows forecasted amount of rice import through neural network method in the next 5 years coming.

To forecast ARIMA method, first, stationary status of variable should be investigated. Hence, Augmented Dickey-Fuller test (ADF) was used. Results showed that rice imports variable is integrated at order one (d=1). Then, autoregression and moving average orders were determined using the Schwartz - Beyzian criterion and ACF-PACF plots. Therefore, based on primary results of previous step several ARIMA model forecasted and among all the mentioned models, best model for forecasting the amount of rice import was selected, using diagnostic test of LQ and forecasting error indices results. The results of ARIMA (3, 1, 3) model are presented in table (2). The results show that rice import will ascend in 2009-2010 and will be fixed in 2012-2013. Table 2.

Comparing of prediction methods

In order to compare the accuracy of ARIMA and neural network in rice import forecasting, RMSE, MSE, MAPE and R2 criteria was used. The results are reported in Table (3). All criteria confirmed the strong accuracy of neural network in forecasting of Iran's rice import. Neural network model has less error and thus better

Table2: Results of Estimating AIMA (3, 1, 3)

Variable		Coefficient	Standard Error
C	Intercept	1408842	6.28*
AR(1)	Rice import with one lag	1.93	0.34**
AR(2)	Rice import with two lags	-1.51	0.49**
AR(3)	Rice import with three lags	1.4	0.21**
MA(1)	Disturbance Term with one lag	-1.89	0.44**
MA(2)	Disturbance Term with two lags	1.74	0.62**
MA(3)	Disturbance Term with three lags	-0.99	-18.37**
	F=51.7	R^2 = 0.74	

*, **, *** significant in level 1%, 5%, 10%

Table 3: Comparing accuracy of forecasting methods

Model	RMSE	MSE	MAPE	R^2
ARIMA	1.67	2.788	1.5	0.55
ANN	0.085	0.0072	0.22	0.84

performance in predicting the amount of rice import.

Hence, present study forecast Iran's rice import based on neural network approach. This point is necessary to recall that the purpose of this research is awareness of increasing or reducing trend of rice import in the next 5 years. Using the neural network the predicted values in 2003 to 2009, showed uptrend until the year 2012, but in 2013 a constant trend will be experience in rice import. The highest growth of rice import in considered period would be 97/2% in 2011. This growth should be considered by policymakers, because uncontrolled increase in rice import could damage domestic rice production.

CONCLUSION

In the present study, two methods were used for predicting the Iran's rice import. Results showed that different methods should be use and compare in order to better prediction of a variable. Because each method has a different answer and results can be compared to achieve a better model. According to results, artificial neural network method, in comparison with ARIMA model, has higher ability in forecasting of rice import. According to these results, it is suggested that planners and policy makers use neural network technique for predicting the desired variables in addition to other methods. Forecasting for future years indicate that uptrend of rice import in 2009 will continue to 2011; and this trend will be fixed during 2011-2013. This can be a threat for domestic production. Uncontrolled entry of foreign rice will be negative consequences on domestic production of this crop. Because, excessive consumption of importing rice change the eating habits. The high cost of rice production, increasing of prices and uncontrolled importing the cheap foreign products cause to reduce consumption of domestic rice and the market is faced to disorder. Therefore, it is for government to impose policies to encourage and support domestic producers more to supply consumption needs and stop this product importing. Also, government and investors should try to decrease the production costs. Integration, equipment and renovation of lands, planning for optimal extraction of water resources, preventing from wasting water, increasing degree of mechanization and biological struggle expansion are the actions which should be taken in rice cultivation.

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