Middle-East Journal of Scientific Research 18 (10): 1436-1439, 2013
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2013.18.10.12417

Forecasting Exchange Rate Using Neural Network Model

[1]Zahoor Ahmad and [2]Lubna Shahzadi

[1]Department of Statistics, University of Gujrat, Gujrat, Pakistan
[2]IIUI, School, Gujrat, Pakistan

Abstract: Apart fromthe factors such as inflation and interest rates, the exchange rate is one of the important factors for economic health of a country. Exchange rates play an important role in level of trade that is critical for free market economy in the world. Due to this reason, exchange rates are the most observed, analyzed and governmentally influenced economic measures. In this paper exchange rates of Pakistan have been is estimated and three year ahead forecast have been provided on the basis of Differentials in Inflation, Differentials in Interest Rate, GDP Growth, Term of Trade (TOT) and Current-Account Deficit (CAD). The Multilayer Perceptron Neural Network Model has been uses for the analysis purpose. It has been observed that the accuracy of estimation and forecasting is very high using the said model.

Key words: Exchange Rates · Multilayer Perceptron Neural Network · Inflation · Current-Account Deficit

INTRODUCTION

An Exchange Rate is the rate at which one nation's currency can be exchanged for that of another. Exchange rates impact and are impacted by, international trade, in a free-market system that helps to maintain a balance of trade and balance of capital.

Exchange rate plays an important role in international trade and finance for a small open economy like Pakistan especially in the era of globalization and financial liberalization. This is because,change in exchange rates influence the productivity ofmultinationals and increase information of exchange to financial organizations and enterprises. A stable exchange rate can be helpful for financial institutions and enterprises inassessing the performance of investments, financing and equivocation and ultimately dropping their operational risks [1, 2]. Fluctuations in the exchange rate may have a considerable impact on themacroeconomic essentials such as interest rates, unemployment, prices, wages and the level of output. This may ultimately results in a macroeconomicdisequilibrium that would lead to real exchange rate reduction to correct forexternal disproportion [3].

Omerbegivic (2005) [4] has noted that: "the appropriateness of the exchange rate is determined by the criteriawhether the current level of the exchange rate that is associated with theequilibrium situation, which is defined in terms of goods and labourmarket equilibrium and the external balance being sustainable, which onthe other hand is determined by the condition of the real economicvariables found in equilibrium.Hence, a proper understanding the determinants of exchange rate helps thepolicy-makers to design appropriate exchange rate policy in achieving the long-runsustainability of the balance of payments."

Numerous factors related to the trading relationship between two countries, determine the exchange rates. Remember, exchange rates are relative measures and are expressed as a comparison of the currencies of two countries.

In this study the focus is on predicting exchange rate of Pakistan on the basis of differential in inflation, differential in interest rate, GDP growth, TOT and CAD by using multilayer perceptron neural network model. In the context of Pakistan no one has used neural network model for forecasting the exchange rate.

Literature Review: There is a lot of literature for forecasting the exchange rate using time series and econometrics analysis but our focus is to review the literature related to use of neural network modeling in the case of forecasting exchange rate.

Corresponding Author: Zahoor Ahmad, Department of Statistics, University of Gujrat, Gujrat, Pakistan.

Huang *et al.* [5] applied neural networks for forecasting foreign exchange rates with noise Reduction. They exposed that predictive models are generally fitted directly from the original noisy data. In this study they applied the nonlinear noise reduction methods to the problem of foreign exchange rates forecasting with neural networks. They concluded that nonlinear noise reduction methods can improve the prediction performance of Neural Networks.

Bissoondeeal *et al*. [6] conducted a comparative study on forecasting exchange rates with linear and nonlinear models using neural network, RW, ARMA and GARCH models. They concluded that nonlinear NN models provide better forecasts against the RW, ARMA and GARCH models. The better performance of nonlinear NN models is stemmed from that they are nonlinear models that exploit the nonlinearity in exchange rate data without the imposition of assumptions of nonlinearity.

Sheikhaand Movaghar [7] predicted the exchange rate using an evolutionary connectionist model and discussed that artificial neural network (ANN) has been applied to time series forecasting. They concluded that foreign exchange rate prediction indicates that the proposed hybrid model effectively improved accuracy, when compared with some other time series forecasting models.

Majhi *et al*. [8] have used efficient prediction of exchange rates with low complexity artificial neural network models and exposed that there was a need to develop efficient forecasting models involving nonlinear and simple ANN structure with one or more neurons. They observed that the CFLANN model performs the best than FLANN and the LMS models.

Pradhan and Kumar [9] forecasted the foreign Exchange Rate in India using ANN Model during 1992-2009. They used two types of data set (daily and monthly) for US dollar, British pound, euro and Japanese yen. Empirical results confirmed that ANN is an effective tool to forecast the exchange rate. The technique gives the evidence that there is possibility of extracting information hidden in the foreign exchange rate and predicting it into the future. They concluded that evaluation of the proposed model is based on the estimation of the average behavior of the above loss functions. Pacelli *et al*. [10] predicted the trend of the exchange rate Euro/USD up to three days ahead of last data available using ANN.

Data and Analysis: The data of exchange rates, GDP growth, inflation, TOT, interest rate and CADis obtained from international financial statistics (IFS), state bank of Pakistan (SBP) and worlddevelopment indicators (WDI) for the years 1980 to 2008. The series of TOT is generated by subtracting the export prices from import prices. The variables, GDP Growth, TOT, interest rateand CAD are generated originally by dividing GDP deflator. Multilayer feed-forward neural network is used for estimation and forecasting and the algorithm of multilayer perceptron neural network model is given in the Appendix.

RESULTS AND DISCUSSION

The basic descriptive statistics of estimated exchange rates are given in Table 1.

The mean and SD of estimated exchange rate is 105.7153 and 7.5814 respectively. Error Mean is the average error (residual between estimated and actual values) of the output variable.Mean Absolute Error (MAE) is a quantity used to measure how close forecasts or predictions are to the observed exchange rate. Error S.D. is the Standard deviation of errors for the estimated exchange rate.Small values of above descriptive indicate the model is best fitted. The standard Pearson-R correlation coefficient between the predicted and observed estimated exchange rate is calculated which is close to 1. The degree of predictive accuracy needed varies in different situations. However,generally a Standard Deviation Ratio of 0.1 or lower indicates very good predictive performance. We can see that value of Standard deviation ratio is 0.0313 which is very small to 0.10 also all the descriptive statistics support our fitted model and lead to high predictive accuracy of fitted model.

The network illustration graphs of Neural Network Model are illustrated. Unit activation levels are (by default) displayed in color, red for positive activation levels, green for negative. Triangles pointing to the right indicate input neurons. These neurons perform no processing and simply introduce the input values to the network. Squares indicate Dot product synaptic function units (e.g. a s found in the Multilayer Perceptrons). Circles indicate Radial synaptic function units. 10 input cases are used in a network for introducing inputs to the network, represented in the triangle shapes. In the graph 1 Radial synaptic function units are used in circle shapes.

Table 2 demonstrates the summary of model.

One network for Multilayer Perceptron provided by Back Propagation and Conjugate Gradient Decent algorithms. Train performance, Select Performance and Test Performance represent the performance of the network on the subsets used during training. Hidden 1 describes the number of hidden units in the hidden layer.

Table 1: Descriptive Statistics

Mean	SD	MSE	Error SD	AMSE	SD Ratio	Correlation
105.7153	7.5814	0.0045	0.2376	0.172	0.0313	0.9995

Table 2: Model Summary

Model	Training/ Members	Training Performance	Training Error	Select Performance
MLP s15 1:15-1-1:1	BP100, CG20,CG151b	0.0313	0.0107	0.00
Select Error	Test Performance	Test Error	Hidden	Hidden (1)
0.00	0.00	0.00	1	1

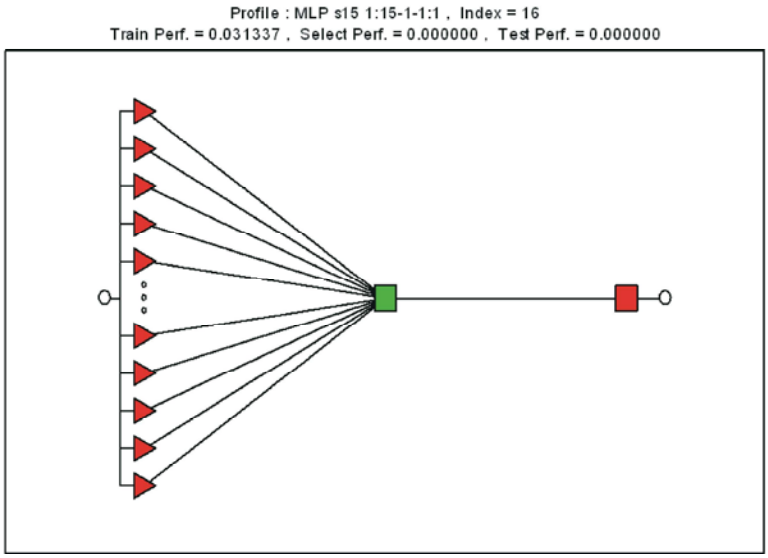

Fig. 1: Network Illustration Graph

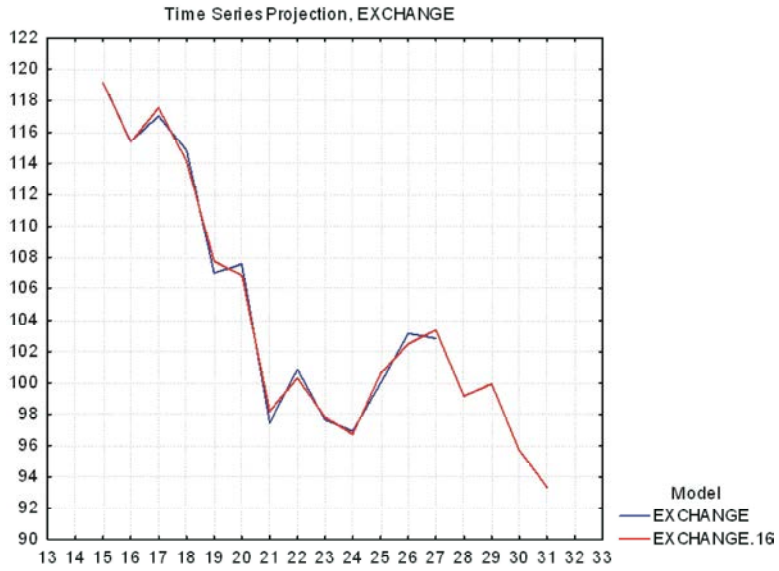

Fig. 2: Time Series Projection

The network MLP (s15 1:15-1-1:1) with 15 steps factor, 1 input variable, 15 input neurons, one hidden neuron and one hidden layer performs best have lowest training error was found on 151 epochs. Training performance is a measure of model performance and also calculated by errors, value close to zero show better performance of model. In this model value of training performance is 0.0313 which is close to zero. All other measure displayed

Table 3: Estimation and Forecasting of Exchange Rate

Year	Actual	Estimated/Forecasted
1995	119.1210	119.1016
1996	115.4220	115.3798
1997	117.0440	117.5697
1998	114.8480	114.1409
1999	107.0380	107.7859
2000	107.5990	106.8868
2001	97.4669	98.2006
2002	100.8720	100.3112
2003	97.6481	97.8278
2004	96.9137	96.7100
2005	100.0000	100.6152
2006	103.1670	102.5018
2007	102.8350	103.3697
2008	100.0400	99.1575
2009		99.9512
2010		95.7058
2011		93.3441

in Table 2, measures the model fitness.Training Error, select performance, select error, test performance and test error having values close to zero, shows the best performance of fitted model which is also shown from descriptive statistics of estimated exchange rate.

Shows the original, estimated and three year prediction of exchange rates and it is observed that there is lowest difference between each observed and predicted value. The predicted values show that there exists a decreasing trend and the same can be observed from Figure 2.

Therefore this model represents the sufficiently accurate prediction and suggests that there exists always a possibility of extort information concealed in the exchange rate and predicting it into the future. The policy makers and investors can also make univariate forecasting by using neural network model. Exchange rate is one measure of economic position of a country so this article will help out regarding prediction of a country's economic condition.

REFERENCES

1. Nieh, C.C., 2005. ARDL approach to the exchange rate overshooting in Taiwan. Review of Quantitive Finance and Accounting, 25: 55-71.
2. Rahman, M.H. and M.I. Hossain, 2003. Exchange rate and investment in the manufacturing sector of Bangladesh. The Bangladesh Development Studies, XXIX(1 and 2): 111-124.
3. Parikh, A. and G. Williams, 1998. Modelling real exchange rate behaviour: A cross-country study. Applied Financial Economics, 8: 577-587.
4. Omerbegovic, A., 2005. Real Exchange Rate in Bosnia and Herzegovina: The Required Adjustment in the Context of Macroeconomic Stability and Accession to the EU. Sarajevo School of Business, Sarajevo.
5. Huang, W.K., K. Lai and S. Wang, 2007. Application of Neural Networks for Foreign Exchange Rates Forecasting with Noise Reduction. Lecture Notes in Computer Science, 4488/2007, 455-461, DOI: 10.1007/978-3-540-72586-2.
6. Bissoondeeal, R.K., J.M. Binner, M. Bhuruth, A. Gazely and V.P. Mootanah, 2008. Forecasting Exchange Rates with Linear and nonlinear models. Global Business and Economics Review, 10(4): 414-429.
7. Sheikhan, M. and B. Movaghar, 2009. Exchange Rates Prediction Using an Evolutionary Connectionist Model. World Applied Sciences Journal, 7: 08-16.
8. Majhi, M., G. Panda and G. Sahoo, 2009. Efficient prediction of exchange rates with low complexity artificial neural network models. Expert Systems with Applications, 36(1): 181-189.
9. Pradhan, R.P. and R. Kumar, 2010. Forecasting Exchange Rate in India: An Application of Artificial Neural Network Model Journal of Mathematics Research, 2(4): 111-117.
10. Pacelli, V., V. Bevilacquaand and M. Azzollini, 2011. An Artificial Neural Network Model to Forecast Exchange Rates. Journal of Intelligent Learning Systems and Applications, 57(3): 57-69.