

MODELLING AND FORECASTING THE ENERGY CONSUMPTION IN BANGLADESH

ABSTRACT

The main purpose of this study is to determine efficient forecasting models of the gas and electricity consumption in Bangladesh. In addition, an attempt is made to identify the important factors affecting the consumption of these two types of energy. For this purpose, yearly gas consumption data for the period 1970-71 to 1992-93 and electricity consumption data for the period 1976-77 to 1992-93 are used.

For determining the important factors affecting energy consumption, step-wise regression analysis and factor analysis are employed separately. Again, before analyzing for modelling, the whole data period is split into two periods, viz., the estimation period and the validation period. Models are fitted for data in estimation period and validations of the models are verified using data for validation period. Three types of econometric models, viz., Growth type, ARIMA type and ANN type, are selected analytically. The predictive performances of these three types of models are compared in two stages. At first, comparison of the predictive performances of pair wise models including tests of the type 'encompassing-inforecasts' are performed. Then the predictive performance of individual model is compared against the values of the criteria R^2 , AME, SAPE, MAPE, RMSE, Chi-square, Theil's U and PC. Modelling to the log-transformed series of energy consumption are also performed.

It has been found from analysis that gas production and electricity consumption are the influential factors for variation of gas consumption. Electricity consumption is significantly affected by gas consumption and petroleum consumption. In case of growth type of modelling, it has been found that quadratic type better performs for transformed and untransformed series of both gas and electricity consumption. Again, in case of ARIMA type of modelling, the investigation has showed that ARIMA(1,2,1) model adequately fits the untransformed and log-transformed gas consumption series, ARIMA(1,2,1) model has been found to be the best ARIMA model for untransformed electricity consumption and ARIMA(1,1,1) model has been found to outperform other types of ARIMA models for log-transformed electricity consumption. On the other hand, in case of ANN techniques, ANN model with a single hidden layer consisting of single neuron has been selected as the best

ANN model for both of the untransformed and transformed gas consumption. The input layer contains a single neuron corresponding to the time period and the output layer contains a single output neuron corresponding to the annual gas consumption. Again, ANN model with a single hidden layer consisting of two neurons in each layer has been found to best suit the untransformed electricity consumption, while, ANN model with a single hidden layer containing a single neuron has been selected as the best ANN model for log-transformed electricity consumption.

Investigation towards the comparison of the predictive performances of the competing three types of models produces the following outputs. Tests of encompassing-in-forecasts for untransformed gas consumption show that none of the three competing models encompasses forecast of anyone of other two models. MGN and WSR test for pair wise equal accuracy comparison indicate that there is significant difference between forecast accuracy of forecasts from ARIMA and ANN models. On the other hand, no significant difference between the prediction accuracy of growth and ANN models, and growth and ARIMA models are found by pair wise equal accuracy tests. Again, forecasting performance of ANN model supersedes other two models by maximum criteria of individual predictive performance comparison. The same thing happens in the case of log-transformed gas consumption. So, ANN model is selected as the best predictive model for untransformed and transformed gas consumption in Bangladesh followed by quadratic model and ARIMA model.

In the case of untransformed electricity consumption, predictive performances of ARIMA and growth models are found to be better than that of ANN model. However, values of the maximum criteria are in favour of better performance of growth model. Again, as far as the considered criteria are concerned, predictive performances of all the three types of models are found to be almost same in case of log-transformed electricity consumption. In this case too, values of the most of the criteria are in favour of better performance of growth model. So, finally, growth model is selected as the best predictive model for electricity consumption in Bangladesh.

The forecasted consumption figures up to 2000-2001 for untransformed and transformed gas and electricity are reported in the study.