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Forecasting Electricity Demand in Iran: The Application of a Hybrid Dynamic Partial Adjustment and ARIMA Model

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Abstract

Goal: Electricity consumption in Iran was reached to historical level of 255,724 million kwh in 2017 which shows 7.7 percent increase compared to the year 2016. Considering the dramatic increase in electrity use mainly due to population growth, urbanization, economic and industrial development, providing a better picture of the future electricity demand for policy makers seems necessary. In addition, specification of the most important variables and their effects on the electricity demand would help policy makers to decide which policy instrument, such as price or non price policies, to choose in order to manage electricity demand.

Methodology: The aim of the present study is to propose and estimate per capita electricity demand function in Iran and forecast electricity consumption over the next 15 years (2015-2029).

To do so, via a dynamic partial adjustment model (DPAM), we first estimated the per capita electricity demand function using historical data over the years 1981-2014 to see the long term and short tem effects of independent variables such as real per capita gdp, real electricity price, real natural gas price as an alternative fuel, and population on electrity demand. Then based on estimated values of the independent variables from an ARIMA model in the hybrid dynamic partial adjustment and ARIMA model, we predicted the electricity consumption up to the year 2029. We used Augmented Dickey-Fuller test to check the unit root in the time series data and we found that none of the variables were stationary and we could not reject the null hypothesis at 5 percent statistical signigficance level. However, the first difference of the variables were stataionary at 5 percent level. We also did Engle-Granger and Cointegrating Regression Durbin Watson (CRDW) Tests and the results show that cointegration exists among the variables.

Results: According to the results, short-term and long-term price elasticities of electricity demand are -0.014 and -0.026 percent respectively which indicate that electricity demand is inelastic with respect to price changes, thus electricity price increase would not lower electricity demand. Moreover, income elasticities both in short-run (0.192) and lon –run (0.36) had much higher effects on electricity demand. Among the independent variables, per capita gdp with coefficient equal to 1.47 had the strongest effect on the electricity demand. Finally, our estimation shows that the cross price elasticities in shor-run and long-run are 0.006 and 0.011 respectively which show that one percent natural gas price decrease would reduce electricity consumption less than one percent. Overally, these reults revealed that price policies are not effective to manage electrity demand.

Based on AIC and SBC criteria, we found that ARIMA (2,1,1), ARIMA(1,1,1), ARIMA (2,1.2) and ARIMA (2,1,2) are appropriate to predict per capita GDP, real electricity price, population, and real natural gar price repectively.The results from the hybrid dynamic partial adjustment and ARIMA mode also show that the average annual growth rate of the electricity consumption per capita between 2015 and 2029 was 2.03 percent and the electricity consumption in 2029 will be 4134.7 million kwh which is 45 percent higher comparing to the year 2015.

Conclusion: To test the credibility of our prediction, we compared the historical figures of per capita electricity consumptions with the predicted numbers by our hybrid model over the years 1981-2014 and realized that the average deviation of the prediction was only 1.3 percent which is in the range of acceptable error level. To cope with this predicted electrity demand, appropriate energy policies including planning to increase electricity production and/or managing electricity demand side must be designed and implemented. Examples of such policies in supply side would be more investment on power plants and their productivity improvement. On the demand side, non-price policies such as consumers educatios and providing better coversion technologies like more energy efficient appliances to consumers are adviced.

Keywords: Forecasting, Iranian electricity demand, Hybrid Model, Dynamic partial adjustment, ARIMA.

JEL Classification: C51, Q41, Q47.

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