THE EFFECT OF A MONOPOLY INCREASING BLOCK PRICING REFORM ON ELECTRICITY DEMAND FOR RESIDENTIAL CUSTOMERS

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Overview

Increasing Block Pricing (IBP) is widely used in the Utility Sector, including in the Korean retail electricity market, because of its income distribution and energy conservation effects. In particular, the Korean wholesale electricity market is a cost-based mandatory-bidding pool market. Therefore, the system marginal price is determined by the marginal cost of the marginal power plant. Its retail market is the single-buyer market; therefore, a state-owned electricity monopoly, Korea Electric Power Cooperation (KEPCO), supplies electricity to the most of the consumers in the nation and its retail price is regulated by the government. Therefore, it is a unique environment in which to evaluate the effect of nonlinear electricity pricing on customer demand. Due to the increasing concern of households with high electricity bills in winter, the government changed its six-stage progressive electricity tariff rate for residential customers to a three-stage tariff system on December 1, 2016. This changed blocking price tariff structure was applied to all residential customers—all 14,728,391 households in the nation. Therefore, in order to evaluate the impact of reducing a stage range from six to three in IBP on consumer surplus, production surplus, and environmental damage, the empirical study was conducted with actual aggregated residential customers' monthly electricity consumption data from 2002 to 2016.

Methods

Autoregressive Distributed Lag (ARDL) Model (1, 4)

Results

First, the previous month's total electricity consumption for residential customers has a positive effect on the present month's electricity demand. The present month's retail electricity price has a positive influence on the the monthly electricity demand, because most customers don't have smart meters so there is a time gap between actual usage of electricity and billing for the amount used. Heating Degree Days (HDD) and Cooling Degree Days (CDD) are both positive influences on electricity demand. However, in this sample period, the residential customer wass more sensitive to CDD.

Second, by forecasting monthly total electricity consumption for the retail customer right before the implementation of tariff reform, we can compare its forecasted demand with actual consumption after the reform is done. After the change of stage range from six to three, total monthly electricity consumption in the residential sector increased by about 4.1% (=220,438,200 kWh). The electricity consumption per household increased by 3.9% (=14.97 kWh).

Third, the wholesale electricity price is increased by 6.4 Won/kWh, because increasing peak demand replaces the current marginal plant with a higher marginal cost power plant due to the merit order effect. Therefore, the electricity procurement cost for the single buyer in the wholesale market increased by $251,128,700.

Fourth, in order to meet the increasing power demand, more expensive power generation using LNG and oil increased by 192.6 GWh and 27.6 GWh. An additional 96,191 tons and 20,197.7 tons of carbon emissions were produced by power generation using LNG and oil sources. Based on the effective carbon rate of 30 Euro/Ton CO, and the basic exchange rate, the total increased carbon cost is $3,679,099

Conclusions

In sum, winter has a high peak demand for electricity for heating and the stage structure change caused a 4.1% increase in the total monthly electricity consumption of households. While customer surplus increased, the revenue of the monopoly firm, KEPCO, decreased because of the combination of a the higher wholesale price and a lower retail price. Lastly, increasing total electricity consumption increases the amount of carbon emission by 116,298.6 tons and carbon cost by $3,679,099. Therefore, before reforming the IBP, policy makers should consider how much the demand on households will increase and the resulting effect on merit-order, reserve margin, and the probability of blackout. In addition, the changes to total social welfare may not be limited to increasing consumer surplus, but may also involve production surplus and the magnitude of environmental damage. Therefore, before modifying the structure of IBP, the effects on the retail and wholesale markets must be carefully considered.

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