Executive Summary

"Welfare Effects of Nonlinear Electricity Pricing"

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Electricity in South Korea is provided by a monopolistic state-owned entity, Korea Electric Power Corporation. This market is heavily regulated: electricity prices are set by agreement between the entity and the government. Particularly, residential electricity pricing in Korea follows a complicated block pricing system. The pricing structure consists of six blocks, each with its own usage fee and fixed fee. The amount of electricity a household consumes determines the block it is put in, and both the usage fee and the fixed fee increase for higher electricity usage blocks. Prices also depend on whether a household resides in a single-family home supplied with low voltage or in an apartment with high voltage. The block pricing system generates a non-convex budget set due to different fixed fees for blocks, and the ratio of the largest usage fee to the smallest usage fee (hereafter, progressivity) is at least eleven times.

The original purpose of implementing this complex residential electricity pricing was to encourage energy conservation and to redistribute income, and thereby to increase welfare. However, whether the current block pricing system has achieved those objectives is controversial. As domestic consumers heavily cross-subsidize industrial consumers, block pricing as a progressive tariff is perceived as unfair. This perception is intensified when domestic consumers experience drastic increases in their electricity bill after a small increase in their electricity consumption. Large differences in prices between blocks make electricity bills unpredictable. As the block pricing system appears to fail the goal of redistribution, policy makers and NGOs suggest reducing the number of blocks and the progressivity between blocks to simplify the price system. However, we are unaware of research that helps to assess the impact on consumer welfare of possible changes in the electricity pricing system.

In this article, we analyze the impact of alternative pricing systems on residential electricity demand, expense, and welfare of consumers by performing scenario analyses. To do this, we first develop a theoretical model to compute each household's welfare change due to alternative pricing systems when it faces a non-convex budget set. Our measurement of welfare change is equivalent variation. Hausman (1981) shows how to compute equivalent variation when a Marshallian market demand curve is known and a budget curve is linear. We modify Hausman (1981)'s method to construct

the formula of equivalent variation for the case of the non-convex electricity pricing that applies to the general convex pricing. Then, we estimate the Marshallian demand function of residential electricity in Korea and predict every household's electricity consumption and expenses under different scenarios. The estimated demand function and consumption levels under alternative scenarios are used to compute every household's equivalent variation. We then use these equivalent variations to calculate social welfare according to Atkinson's inequality aversion indices.

Our results indicate that consumer welfare would be higher under alternative scenarios. Additionally, the large price difference between the first block and the last block under the current pricing system suppresses demand increase. Electricity demand and welfare increase for all income groups under alternative pricing systems. Moreover, when a society wants to protect low-income households, three-tier systems with progressivity value of three achieve greater social welfare than six-tier pricing systems or flat charges. This suggests that a tier system should be maintained to protect low-income households, but that the number of blocks and the price difference between blocks should be reduced from the current level.