Rebound Effects of Electricity Efficiency Improvements in Iran: A CGE Approach

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Abstract:

Electricity efficiency improvement policies are unavoidable in Iran due to the low level of efficiency in production, high growth rate in consumption, high rates of transmission losses and global advices for clean development. The first likely impact of efficiency improvement is decrease in demand; but it may not be as much as it is generally expected. The "rebound effects" may get in the way and reduce the size of the ‘energy savings’ achieved. The rebound occurs when the increased efficiency decreases the effective price of energy and consequently increase the demand will increase. Hence, ignorance of these effects in policy making causes overestimation of the benefits of efficiency improvement policies (Khazzoom, 1987). Analysis of rebound effects, especially in the context of macro-economy, is a new field of economic research and recently, there have been extensive debates in the literature on the impacts of energy efficiency improvements (Turner, 2009; Sissine, 2006; Grepperud & Rasmussen, 2004).

The idea of this paper is to determine the parameters that influence the magnitude of rebound effects theoretically and to evaluate the consequences of an exogenous and costless efficiency improvement in electricity use in the context of a computable general equilibrium model. This model includes 12 production sectors, rural and urban households, government and finally imports and export sectors. The three main assumptions of CGE modeling, namely market clearance, income balance and zero profit condition for each sector are included in our proposed model. After calibrating the model, we analyze the impacts of 10% electricity efficiency improvements in all sectors. We assume that efficiency improvement is exogenous and costless.

We found that electricity efficiency improvement will result to rebound effects of 14.2%. This means that 14.2% of primary decrease in demand is offset by rebound effects. According to our results, there are significant differences of rebound effects across electricity consuming sectors. Oil and Gas sector faces highest rebound effects. Sensitivity analysis to test the response of rebounds to the specification of elasticity of substitution between electricity and fossil fuels shows that, economy-wide rebound effects changes from 11.6% to 14.2% due to changes in elasticity of substitution from 0.1 to 0.9, which implies the robustness of the results to different elasticity of substitution.

Key words*:* Computable General Equilibrium; Electricity Efficiency; Rebound Effects, Iran.

JEL: C68; D12; D21; D58; Q41; Q43

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