Understanding energy use and climate change mitigation response at sectoral level based on detailed econometric models

Shyamasree Dasgupta (1) and Joyashree Roy (2)

(1) School of Humanities and Social Sciences, Indian Institute of Technology Mandi, India (shyamasree.dasgupta@gmail.com), (2) Department of Economics and Global Change Programme, Jadavpur University, Kolkata, India

In climate change mitigation literature, one of the thrust areas is to understand the behaviour of energy demand sectors of an economy. In-depth understanding of responses of these sectors to past energy and climate related policies are essential to design future policies in an effective manner. This is also crucial to estimate the future emission pathways. In presence of long term and secoral data econometric models are extremely useful to derive several behavioural parameters which can be incorporated in the integrated assessment models. Against this backdrop, we have carried out several econometric studies to understand the energy use and climate change mitigation behaviour of Indian industrial sector during a long period of time (1974-2012) to understand their behavioural responses based on estimated robust parameters. Availability of the results of more such studies can bring about significant precision in climate change mitigation studies.

The framework of analysis is based on the neoclassical theory of producers' behaviour. Given the assumption of weak separability, we have constructed overall cost functions and energy sub-model within cost functions where energy cost is expressed as a function of multiple fuel prices in a translog form. Assuming contemporaneous correlation in the error we have then carried out econometric estimations under the assumption of Zellner's Seemingly Unrelated Regression Equations (SURE). The estimated parameters are interpreted to understand the energy and other input use behaviour in long term, role of technological progress- both autonomous and policy induced, the bias in technological progress, response to change in energy and other input prices, input-substitution possibilities, specific energy use and emission mitigation behavours including feasibility of inter-fuel substitution given the state of technology and behavioural response. The estimated parameters from the econometric model are also helpful in understanding emerging issues such as the interaction between technological progress and rebound effect. Annual Survey of Industries published by Central Statisitcal Organization under the Ministry of Statistics and Programme Implementaion, Governement of India and the Wholesale Price Indices published by Reserve Bank of India are the main data sources. This study also gives an understanding how to make use of available data to create important economic variable to be incorporated in such econometric models.

Results suggest that these industries experienced long run technological progress, although for most of the industries such technological progress exhibit significant energy saving bias only during the recent years. The price responsive behaviour suggests that historically increase in energy price induced energy demand reduction and technological progress in most of the industries. Estimates also suggest that rebound effect is less likely to neutralise the gains from energy efficiency policies in the context of these industries. Results also suggest that while change in fuel price in itself may not be very effective towards inter-fuel substitution in favour of electricity, but behavioural response will be conducive if technological progress shows biases towards electricity. However, one should consider the fact that electricity cannot always economically supply all industrial energy services where intense source of heat would be required.