ESTIMATING THE MACROECONOMIC REBOUND EFFECT IN CHINA

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Overview

It seems intuitive to think that improving the efficiency of energy use will lead to a reduction in energy consumption. Evidence from history and empirical research, however, tells us that an increase of the energy efficiency does not always result in decrease of energy consumption. Since the 1980s, researchers have been intrigued by the idea that improving the efficiency of energy use may not lead to a reduction in energy consumption, a concept termed the rebound effect.

Many papers on the rebound effect have been published in the energy economics field since 1980s. However, most of the empirical papers mainly focused on the residential sector and transportation sector in order to estimate the direct effects and secondary effects; Few people have studied the size of rebound effect at the economic-wide level until now. The purpose of this paper is to estimate the size of China's macroeconomic rebound effect.

Methods

In this paper we use three definitions to estimate the rebound effect in China: the price elasticity of energy demand definition, the ratio of actual energy savings (AES) to potential energy savings (PES) definition, and the energy efficiency definition.

In the price elasticity of demand definition, the estimates of price elasticity provide the nearest possible empirical indications of the size of the rebound effect. The size of the macroeconomic energy rebound effect is equal to the negative of the estimate of the price elasticity of energy demand. Both an Instrumental Variable (IV) model and an Error Correction Model (ECM) are used in this section to estimate the elasticity over the short and long term.

In the AES/PES definition, the rebound effect can be expressed as RE=1-AES/PES, which is the initial meaning of rebound effect. Based on the expansion of equation, it is straightforward to calculate the rebound effect after total factor productivity is estimated. The production function we use in this section is two-level CES production function. Since this production function is highly nonlinear, we use a nonlinear least squares (NLLS) model to obtain estimates of all parameters.

In the energy efficiency definition, energy and energy services are distinguished in this section. It is energy services, rather than energy, that should be included in the two-level CES production function as an independent

variable. By using nonlinear least square (NLLS) method, we estimate the value of parameters in the production function using macroeconomic time series data.

Results

First, by using IV and ECM methods to estimate the price elasticity of energy demand for the price elasticity of demand definition, the short term direct own-price rebound effects for China's industrial sector were estimated at 69% and 158%, respectively.

Second, in the AES/PES definition, the estimation results show that the long-run province-level rebound effects are lower than 10% for all provinces except Ningxia and Qinghai.

Third, in the energy efficiency definition, the result show that except for a drop in the early 2000s, the national rebound effect increased over time from 1981 to 2009, from approximately 48% to approximately 56%.

In summary, our estimates of the rebound effect results from all three definitions are positive. Moreover, they are all less than 1, except the price elasticity definition when using ECM method, which, in contrast to the other methods, measures a short-run direct effect. Our results therefore suggest that there exists a rebound effect in China, but one that is less than 100%. The differences in the results from our various definitions are likely due to the differences in the scope of the rebound effect they estimate.

Conclusions

Based on the results, we believe that there exists a positive rebound effect for the total energy consumption in China, as well as for China's industrial sector. The rebound effect is an important factor that the government of China should not neglect when making energy policy.

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