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# Comparability of estimating energy rebound effect should be based on uniform mechanism and benchmark: A reply to Du and Lin



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## HIGHLIGHTS

- A reply to Du and Lin (2015), who questioned our previous study, is provided.
- Their criticism logic does not originate from our corresponding mechanism.
- Their estimation formula has a different benchmark with ours.
- Different data samples in the two papers make their results incomparable.
- Their argument is not enough to overturn our previous study.

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## ABSTRACT

Du and Lin (2015) argued that the estimation model of the economy-wide energy rebound effect proposed by Shao et al. (2014) should be revised and provided an alternative approach, which they considered to be more consistent with the definition of the rebound effect. However, in this comment, we do not find a valid correction or modification to our original model, because their criticism logic does not originate from the corresponding mechanism in Shao et al. (2014), and their estimation formula has a different benchmark with ours. Moreover, their data samples were also different from ours, generating the incomparable results, and there are some irrational results in the comment. Even based on different estimation formulas in the two studies and using the same estimation method and data sample, the comparison results show that the problem of the estimation formula in our previous study which they claimed does not really exist. We argue that this comment is not consistent with the principle of the rebound effect. Actually, their work can be only regarded as proposing an alternative approach for the estimate of the rebound effect. Therefore, their argument is not enough to overturn our previous study.

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## 1. Introduction

Du and Lin (2015) argued that the formulas in Shao et al. (2014) should be revised and advocated the distinguishment between energy efficiency improvement and technological progress for estimating the energy rebound effect. They emphasized that our method was not accord with their endorsed definition of the rebound effect. Accordingly, they proposed another approach to estimate China's economy-wide energy rebound effect by using different data samples rather than to revise our model. However, by observing the "revised formulation" and discussion in Du and Lin (2015), we do not find a clear statement on the theoretical mechanism of the rebound effect. Instead, they only

gave a highly simplified model diagram to describe the function mechanism of economy-wide rebound effect. We argue that the mechanism does not strictly apply to our model and cannot provide a reasonable support for their approach. Actually, there is not a necessary correlation between their theoretical mechanism and following model. Moreover, the data samples used by the critics are different from ours, generating the incomparable results. Furthermore, we find that their estimate has the problems of the rigorousness of obtaining formula and the rationality of results. If the researchers do not understand or misunderstand the basic idea of the rebound effect, they may be caught in the confusions of substituted scenarios and renamed concepts. We believe there are various approaches to estimate the rebound effect. Also, we respect those estimation programs based on the background facts and scientific methods. However, it should be another topic to compare different estimation methods.

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Therefore, we believe that this comment is not enough to overturn our previous study.

## 2. Conceptual and logical flaws

Two crucial issues are discussed as follows, which hint the principal errors in the comment of Du and Lin (2015).

### 2.1. Basic idea of the rebound effect

The definition and classification of the rebound effect have been introduced in many previous studies. The differentiated understanding about the definition of the rebound can lead to its diversified estimation methodologies. In our opinion, the basic idea of the economy-wide rebound effect is that once the improvement in energy efficiency can propel technological innovation and economic growth, the increased economy-wide energy consumption will generate due to the productivity growth enabled by energy efficiency improvement. Berkhout et al. (2000) gave the detailed discussion for defining the rebound effect and considered technological progress as the most important source of energy saving. Madlener and Alcott (2009) believed that technological progress and substitutability play the key roles in the relationships among energy consumption, energy efficiency, and economic growth.

As shown in Fig. 1, in a certain sense, technical change and the substitutability among production input factors represent the basic idea of the rebound effect since they exert important but usually ambiguous impacts on all pairwise relationships. Therefore, the function mechanism of economy-wide rebound effect is generally complex and diversified. Any highly simplified theoretical mechanism is unable to completely illuminate the practical function process of the economy-wide rebound effect and only may provide some abstract explanation from a certain aspect.

### 2.2. Logic errors

Du and Lin (2015) designed a theoretical mechanism of economy-wide rebound effect and illustrated Fig. 2 to describe it. However, such a mechanism is not one explicated in our previous study, and in a sense, their mechanism just shows the deficiency of some existing studies which we have pointed out. As shown in Fig. 2, the demand curve, supply curve, and production curve not only can be used to reflect a single commodity market, but also to describe the overall economy. Whereas, the critics did not specify what is the aimed market. According to such a mechanism, if the rebound effect appears, the hypotheses of rational choice and complete information are needed, and otherwise it will lack

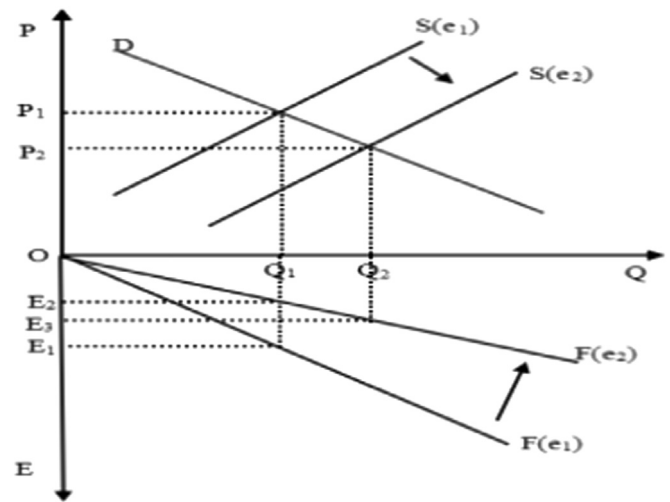


Fig. 2. Illustration of economy-wide energy rebound effect. Source: Du and Lin (2015).

enough incentive to move the curves. We do not discuss the correctness of their mechanism for the moment, and what we firstly concern is that when a theory mechanism is proposed, even if this mechanism has not been reported in other studies, could it still be used as the main basis to criticize the previous studies?

There are two logical fallacies in the comment of Du and Lin (2015) to our previous study: (i) if the theoretical mechanism of economy-wide rebound effect shown in Fig. 2 is applicable to our previous study, while it is not the main component of our work, the criticism will lose its foothold; and (ii) if their mechanism does not apply to our study, but only applies to their work, using it as the main evidence to evaluate our model and method, especially the LVA, will lose its legitimacy. Further, what we are still very curious about is that if their mechanism is not applied to our study, can we regard the model following their mechanism as a better one than what we used? Even if we assume that their mechanism can prove our model with some problems, would their method unrelated to our model be better? Where is the logic connection? To a great extent, their comment can be classified as the introduction of an alternative estimation approach. In addition, with respect to the contents of this comment, their theoretical mechanism and model can be regarded as the general discussions on the rebound effect, respectively, and there seems to not be a close correlation between them.

## 3. Methodology

Shao et al. (2014) introduced an alternative estimation model of economy-wide energy rebound effect, and the definition of the rebound effect they used has been widely adopted in previous studies (Berkhout et al., 2000; Haas and Biermayr, 2000; Jin, 2007; Druckman et al., 2011; Chitnis and Sorrell, 2013). Also, our estimation method mainly employs the latent variable approach (LVA) to handle the difficulty that technological progress rate cannot be directly observed. Du and Lin (2015) did not present any opinions on the LVA, but mainly questioned our previous theoretical model and estimated results. We believe that their questions could not gain a firm footing due to five reasons as follows.

### 3.1. Rigorousness of obtaining formula

Based on the theoretical mechanism of Fig. 2, Du and Lin (2015) suggested our formula should be revised as:

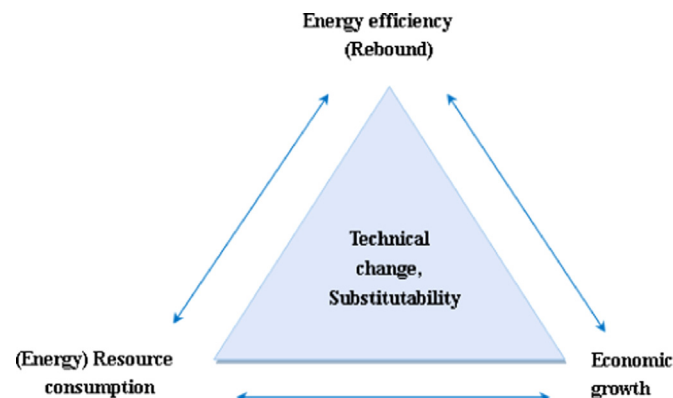


Fig. 1. Energy efficiency (rebound), resource consumption, and economic growth. Source: Madlener and Alcott (2009).

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