

INTERACTION BETWEEN ELECTRICITY MARKET REFORM AND CARBON PRICING: INSIGHTS FROM A STRENGTHENED SCRUTINY FOR CARBON LEAKAGE IN CHINA

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Overview

To actively drive the supply-side reform led by China's Energy Revolution, de-capacity in coal industry has long been viewed as a breakthrough point. However, the year of 2016 has witnessed an unpredictably sharp increase in the coal price, leading to a substantial suffer to the power sector due to the inexistence of cost pass-through mechanism in regulated electricity market. This issue will be restructured by ongoing reform but not yet so far, thus from both policy and profit-seeking perspectives, a great progress can be expected to emerge in 2017. With the deepening of electricity market reform in China, electricity market is anticipated to be much more competitive than before. It gives a clear indication that the cost pass through mechanism will be progressively established, and the indicator of cost pass through rate (*CPTR*) won't remain zero any more. In contrast to the regulated electricity pricing system, *CPTR* makes it possible for power industry to transfer their carbon cost downwards. In effect, there is no need for the national carbon market to cap the indirect emissions and manually impose the associated cost, which is the case in current pilot carbon markets. This may significantly influence the design and development of the national carbon market. Hence, this paper explores the interaction between electricity market reform and carbon pricing in China through an in-depth quantitative assessment on the carbon leakage concerns at the four-digit sector level. Furthermore, sensitivity analyses of auctioning factor and coverage of carbon market are conducted to reflect potential effects of electricity market reform on future development of carbon market. To conclude, this study emphasizes that the design of carbon market and its complementary measures should be treated with discretion to assure the synergy along with the progress of electricity market reform.

This paper is structured as follows: After the introduction, the second section outlines the historical electricity market reform in progress in China. The third section overviews studies on *CPTR*, including the qualitative assessment of market structure elements that influence the cost pass-through mechanism. The fourth section presents quantitative methodology to align carbon market design with the progress of electricity market reform, taking *CPTR* as a bridge indicator. The fifth section shows the comparative analysis and discuss over the assessment results. While, the last section concludes the interaction of electricity market reform and carbon pricing in China and proposes some recommendations.

Methods

The current research adopts carbon intensity (*CI*, measured by emission per unit of value added in given sectors) and trade intensity (*TI*, measured by share of international trade volume in overall output for given sectors). These two indicators were first proposed in Article 10a of the amended Directive 2003/87/EC. The first indicator can be used to present the additional cost from auctioned allowances and carbon costs; this indicator is expressed as CO₂ cost as a share of gross value added. Meanwhile, *TI*, which is defined as the sum of the export and import values as a share of the total scale of a domestic market, indicates the capability of industrial sectors to transfer their carbon costs to end-use consumers. A considerably higher *TI* indicates that sale price in a specific sector is decided more internationally than domestically, with less possibility to compensate itself by increasing the price.

Results

Power generators as participators of carbon market: the Nash Equilibrium Solution of the game that power generators as participators of carbon market is $CPTR=100\%$ & 100% of free permits. The feedback from power generators is to appeal a higher level of liberalization and fast progress of electricity market reform in China.

Industrial sectors as participators of carbon market: results show that allocating 15.8% of total emission permits for free is sufficient to compensate those sectors deemed at risk of carbon leakage in regulated electricity market, whereas the fraction varies from 7.9% to 17.0% under various cost pass-through scenarios.

Industrial sectors outside the carbon market: the electricity market reform will drive the electricity pricing system to be more liberalized, and also incur additional cost to those sectors outside carbon market. The results of scrutiny indicate that the compensation, measured as equivalent free permits, needed in different scenarios can vary greatly, but remains positive correlation with the progress of electricity market reform, ranging from 0% -

4.5% in scenario without carbon tax and 0.1%-5.6% under carbon tax policy, which are quite considerable in contrast to the proportion of free permits needed by sectors inside carbon market (7.9%-17.0%).

Conclusions

It turns out that whatever the allocation approach is, generators will benefit in a more competitive electricity market. Therefore, the feedback from power generators is to appeal a higher level of liberalization and fast progress of electricity market reform in China.

Notably, for occasions that reform fails to advancing smoothly, the obstacle to fully transfer carbon costs downwards will hinder innovation in end-use energy technologies, albeit the limited carbon leakage risk. To some extent, it proves that current compromising treatment of emission permits in pilots is acceptable. Therefore, this study suggests that at the first stage of China's carbon market, the emission permits should still be allocated to direct and indirect emissions concurrently.

Additionally, the electricity market reform evidently doesn't make it much more difficult for the design of carbon market from perspective of addressing carbon leakage. With due to the great uncertainties related to the progress of electricity market reform, it seems to be quite reasonable to conclude that some stages of electricity market reform even considerably decrease the risk level of carbon leakage.

Furthermore, it's evident that the extent of complementary measure doesn't change significantly, only 1.1% higher at most in case that carbon tax is levied on those sectors outside carbon market, compared to up to 20 sectors will be further deemed at risk of carbon leakage when levying carbon tax in an electricity market becoming more liberalized stepwise. In this respect, the reform might incur unfavorable effects on the feasibility and acceptability of carbon tax policy, as more sectors than in carbon market should be compensated and policy makers have to spend more labor and financial resources negotiating with delegation of these sectors.

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<https://doi.org/10.1016/j.resconrec.2016.09.017>