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Company's affordability of increased energy costs due to climate policies: A survey by sector in China

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ABSTRACT

This paper estimates the affordability of Chinese companies on energy cost increases due to the introduction of market-based climate policies. The data were collected from 170 respondents mainly from iron and steel, cement and chemical industries, using a multiple-bounded discrete choice (MBDC) format. Estimations indicate that a mean of 8.8% in energy cost increase would be acceptable for all the samples. The chemical companies express a slightly higher affordability, with the mean of acceptable ratios of energy cost increases being 9.9%, while the cement companies show slightly lower affordability with a mean of 7.7%. Econometric analysis confirms that the market competition degree has a significant but negative relationship with the affordability while the company's size is significantly and positively associated with the affordability. Calculations indicate that the mean of affordable energy cost increases roughly equals a carbon price of 83.7 CNY/t-CO_2 (about 12 USD/t-CO_2) for chemical companies and around 40 CNY/t-CO_2 (about 6 USD/t-CO_2) for iron and steel and cement sectors. This result provides a meaningful referendum for the development of carbon tax and the establishment of a domestic carbon emissions trading scheme in China, especially from the perspective of surveyed industries.

1. Introduction

Market-based instruments (MBIs) provide incentives for polluters to reduce harmful emissions by appropriately defining prices or property rights and are viewed as more cost-effective policies compared with command-and-control approaches. In the field of climate change, carbon taxes and greenhouse gas emissions trading schemes (GHG ETS) discourage the use of fossil fuels by increasing the costs of energy uses and related CO_2 emissions. In spite of debates on the advantages and shortcomings of MBIs as climate change countermeasures, carbon taxes implemented in several European countries have shown broad and positive effects in reducing the use of fossil fuels and CO_2 emissions while yielding very slightly negative impacts on the economic growth (Andersen and Ekins, 2009). The recent and famous EU-ETS, covering around 11,500 factories and 40% of the EU's total CO_2 emissions, is expected to enable EU countries to realize their Kyoto obligations effectively (Sovacool and Brown, 2009). Nevertheless, the adoption of MBIs for improving energy efficiency and mitigating CO_2 emissions has been much slower in Northeast Asia including China (Liu et al., 2011). Discussions have been emerging on the roadmap for China to introduce carbon tax among experts at the research institutes under related ministries (Li, 2010; Wang et al., 2009). The expected policy efficacy would be marginal since the proposed tax rates are very conservative, at about 1.5 USD/t-CO_2 for the initial phase (Su et al., 2009). Establishing an integrated domestic carbon market was first mentioned in an official document of Chinese central government in 2010. There is still no specific decision on how to determine emission caps or the timetable for the formal introduction of a domestic carbon ETS (Liu, 2010). Nevertheless, a number of local environmental exchange institutes were consecutively set up across the country before a regular carbon market could be established, such as the 'China Beijing Environmental Exchange', the 'Shanghai Environment and Energy Exchange' and so on. These institutes have carried out some trading of voluntary emission reductions (VERs) (Zhang and Li, 2010). The market of VERs is obviously limited as Chinese companies have no motivation to offset their CO_2 emissions voluntarily at current phase.

On the other hand, there remains a large potential of energy saving for Chinese companies due to the technology gap and irrational structure of industries. The continuous energy-saving efforts of the industrial sector would greatly contribute to the realization of national overall targets for energy efficiency improvement. It is necessary for China to make use of MBIs for enhancing industrial energy efficiency in a cost-effective way. Practically, the acceptance of

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companies as major policy targets is essential in determining the progress and actual success of new policies. From the viewpoint of traditional economic theory, the company's acceptance of a policy would be mainly affected by the cost attributed to the policy introduction and implementation. Aiming to support the ongoing discussions of carbon tax policy and GHG ETS from an industrial perspective in China, this research estimates the affordability of companies with regards to energy cost increases due to the phase-in of these policies. Three energy-intensive sectors, iron and steel, cement and chemical industries, were targeted in our study. Two topics are discussed in this paper. One is the estimation of policy cost affordability of companies in the three target sectors expressed by energy cost increase ratios. The other is to identify the determinant factors, external and internal, affecting the estimated cost affordability.

The remainder of this paper is structured as follows. Section 2 presents a review of related literature and the contribution of this research. Section 3 explains the methodologies, including the models for estimating the cost affordability of companies by multiple-bounded discrete choice (MBDC) data, and the analytical framework for identifying the determinants of the estimated cost affordability. Section 4 briefly introduces the background of the three target sectors. Section 5 outlines the questionnaire survey and the distribution of samples by sector and organizational size. Section 6 discusses the results of affordability estimations and econometric analysis. Lastly, Section 7 concludes the research findings.

2. Literature review and contributions of this research

Broad analyses have discussed the policy measures for enhancing industrial energy efficiency (Schleich, 2009). Industrial energy programs such as energy audit and long-term agreements (LTAs) are often applied for promoting energy efficiency in industry (Thollander and Dotzauer, 2010). Rietbergen et al. (2002) concluded that a large portion of energy savings in Dutch manufacturers can be attributed to the LTAs. Social mechanisms by establishing regional or local learning networks of companies are useful to motivate the improvement of energy efficiency in Switzerland and Germany. Substantial progress was confirmed in energy efficiency of the network participating companies (Jochem and Gruber, 2007). Klok et al. (2006) found an overall preference of Danish companies to voluntary approaches, such as energy efficiency labeling, rather than command and control regulations even the surveyed companies agreed on the necessity of certain mandatory requirements. The empirical evidence is mixed on the effectiveness of subsidy policies. Unlike carbon tax and GHG ETS raising prices of energy use and related CO_2 emissions, financial subsidies do not provide incentives for the companies to quit the polluting technologies (Jaffe et al., 2005). Kounetas and Tsekouras (2008) examined the adoption of energy efficient technologies by Greek companies and found that the companies who have been granted greater capital subsidies and whose production is energy-intensive are more likely to adopt energy-saving technologies. Smaller or financially constrained companies are more susceptible to capital incentives than their larger or less constrained counterparts (Skuras et al., 2006). In practice, the success of policies for improving the energy efficiency and lowering the carbon intensity highly depends on the ability of policy makers to predict how the industries respond to various policy measures (Martin et al., 2012). Effective policies should provide incentives for not only short-run improvement in energy efficiency but also technology research and development leading to sustainable efficiency growth in the future. From the viewpoint of individual companies, raising energy costs functions as an important driver for them to improve energy efficiency, especially for the energy-intensive industries (Bunse et al., 2011). Only a small number of industries would bear a disproportional burden of a carbon tax or similar policy (Morgenstern et al., 2004). Therefore, carbon tax policy should aim to change the emitter's behavior rather than to raise the government revenues. Some companies view the taxation as an effective instrument if combined with sector agreements and the minimum efficiency requirements (Klok et al., 2006).

Employing a set of panel data of China's most energy-intensive and large and medium-sized companies during 1997 to 1999, Fisher-Vanden et al. (2004) identified the rising energy prices as a principal driver of their declining energy intensities. Andrews-Speed (2009) examined the context of nearly 30 years of measures for the enhancement of energy efficiency in China and addressed a number of constraints including the reluctance to use economic instruments. China has been involved in international carbon market through the project-based Clean Development Mechanism (CDM). Critics claim that the scale of CO_2 emissions reductions of the CDM projects is insufficient and the project-based crediting process is inefficient (Lewis, 2010). Levying carbon tax is viewed as not only an economic means to combat global warming but also an important strategy for energy-saving and sustainable development of China (Wei et al., 2011). Based on a review of empirical analyses of carbon and energy taxes, Zhang and Baranzini (2004) concluded that competitive losses and distributive impacts are not significant as being usually perceived. Considering the difficulty of tax collection, the carbon tax proposal of Chinese experts opts to levy taxes on fuel-containing carbon emissions. Concerning the negative impacts of carbon tax on the economy and industrial competitiveness, the proposed carbon tax rates are quite low (Liu et al., 2011). Since China's economic development is still accelerating, the country's GHG emissions will inevitably increase in the long term. It is hardly for Chinese government to put specific ceilings for its overall carbon emissions in the near future. Limitation on CO_2 emissions implies that the labor demand of energy-intensive industries would decrease and thus may cause a rise in unemployment along with the workforce being replaced by more advanced production lines (Cai et al., 2009).

Therefore, clarification of the opinions of various stakeholders is necessary to facilitate the ongoing discussions on carbon pricing policies including carbon tax and GHG ETS in China. The introduction of these politically uncomfortable but effective measures is critically determined by the acceptability of industrial companies as major policy targets. Our earlier policy overview and comparative analysis in Northeast Asia confirmed that strong resistance from the industries has been the most crucial factor blocking the carbon tax policy in Japan and Chinese companies would be also reluctant to this new tax at the beginning (Liu et al., 2011). There have been some studies simulating the impacts of carbon tax policy on economy growth and carbon mitigation in China using macro-economic models (e.g. Cao et al., 2012; Liang et al., 2007; Su et al., 2009). However, it is surprising that very limited research has concerned the viewpoints of companies at the bottom. To the best of our knowledge, this survey is the first attempt to estimate the affordability of companies regarding the costs originated from market-based climate policies even some literature has explored the policy acceptability of individual people (e.g. Bristow et al., 2010; Wang et al., 2012). In terms of methodological contribution, this study is a novel extension of MBDC format, a contingent valuation (CV) method frequently applied for the quantification of personal willingness-to-pay (WTP) for environmental improvement in the past, to the company level. In spite of the inherent difficulty for the survey arrangement to businesses, we tried to collect the responses mainly from the three target sectors as much as possible by various efforts to satisfy the simulations and statistical analysis. As the result, the estimated carbon prices affordable for the surveyed companies provide some meaningful implications for facilitating the progress of carbon pricing policies in China.

3. Methodologies

3.1. Estimating affordability of energy cost increases for companies

3.1.1. Multiple-bounded discrete choice questionnaire

As described above, the CV method has been widely used to estimate the people's WTP for environmental improvement or