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How consumers are willing to pay for low-carbon products? – Results from a carbon-labeling scenario experiment in China

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ABSTRACT

Carbon labeling has been recently developed to lead the public towards lower carbon consumption in an attempt to create a low-carbon economy. By identifying the greenhouse gas emissions produced during the full life cycle of a product, carbon labeling can affect the behavior of the consumers who purchase low-carbon products. Based on data from a carbon-labeling scenario experiment conducted by the research group in six cities throughout China, we adopted the Dunnett's T3 test approach for single factor variance analysis to find the differences in consumers' willingness to pay for low-carbon products between different types of consumers. Then, we used a logistic regression model to analyze the relationship between the consumers' willingness to pay and their demographic variables. The results indicate: (1) significant differences exist in the willingness to pay for low-carbon products for different consumers, and (2) education level and monthly income significantly impact consumer willingness to pay. Based on these findings, we proposed relevant policy implications.

1. Introduction

Cleaner production and consumption are two sides of the same coin. Much work has been conducted to increase clean production. With the growth of the global economy, consumption has significantly affected the environment. Cleaner consumption can reduce environmental harm while minimizing public health impacts. Low-carbon consumption through a carbon-labeling scheme will undoubtedly induce cleaner consumption. Carbon labeling of consumer products indicates the amount of CO_2 emissions (i.e., the carbon footprint) of a product for its full life-cycle, including raw materials, manufacturing, storage, shipping, marketing, consumption and disposal, which are quantified (Yingfei Hu et al., 2010). Product carbon labeling will not only publicize sources of emissions to encourage manufacturers to reduce CO_2 emissions into the environment but also lead consumers towards low-carbon consumption to reduce greenhouse gas emissions and mitigate climate change (Jie Wu and Qi Jiang, 2009). However, the retail prices of low-carbon products with carbon labels are higher than conventional products due to the additional costs of low-carbon certification and technologies.

The decision to purchase a low-carbon product can be described as a public goods game. Matjaž Perc and Attila Szolnoki (2010) argue that evolutionary game theory provides a theoretical framework to address the subtleties of cooperation in social dilemmas. Matjaž Perc et al. (2013) reviews a study of group interactions that are representative of public goods games, while Attila Szolnoki et al. (2012) argue that the "wisdom of groups" can promote cooperation in evolutionary social dilemmas. Xiaojie Chen et al. (2012a) emphasize the importance of adaptive and bounded investment returns for the emergence and dominance of cooperative behavior in spatial public games. Xiaojie Chen et al. (2012b) argue that their results support the importance of percolation for the successful evolution of public cooperation and reveal simple methods of self-organization towards socially desirable states. Xiaojie Chen et al. (2012c) also demonstrate that stronger feedback between group performance and risk level is more favorable to the evolution of public cooperation if the collective target is moderate. Meanwhile, consumers perceive carbon labeling practices differently according to their awareness, attitudes and actions towards more expensive low-carbon products. Therefore, it is important to explore differences in the willingness to pay for low-carbon products among consumers through experimental and statistical methods.

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2. Literature review

Research on carbon labeling began recently and focuses on the following four aspects: carbon footprints, impact on international trade, CO_2 emissions reduction and consumer willingness to pay for low-carbon products.

2.1. Research on carbon footprints

Yrjö Virtanen et al. (2011) take micro and macro level approaches to produce consistent results for the environmental hot spots within the Finnish food sector; they identify a growing possibility to use EIO-LCA approaches in the food sector. Ian Vázquez-Rowe et al. (2012) assess the environmental profile of hake fish sticks extracted in Chile and processed near Vigo (NW Spain) for distribution throughout the Spanish market from a GHG emission perspective, and the examined fish sticks constitute an attractive alternative to other protein-based food products. Antonio Scipioni et al. (2012) integrate the main ISO standards for GHG emissions and determine that the model supports the establishment of enterprises and management of emissions related to products throughout their life cycle.

2.2. The impact of carbon labeling on international trade

Carbon labeling has already become a fashionable topic in the field of international trade (Jiemin Chen, 2010). Carbon labeling certification systems have been developed in Europe, America, Japan and other industrialized countries that involve carbon labels for consumer products; these systems are likely to become new technical barriers to trade (Zeyong Chen, 2010). Simon Bolwig and Peter Gibbon (2009) note that international standards of carbon footprint certification will soon be established. Moreover, the inflow of biofuels into the EU market has already been carbon labeled, and other products will follow in 10–15 years, which suggests that carbon labeling will become a barrier to market access. If the export commodities of a country fail to receive carbon labeling certification, they will face exclusion from the international market. O. Nartova (2009) analyzes the possible moral, economic and legal effects of carbon labeling on world trade and concludes that it is still possible to implement carbon labeling under the current technical terms of WTO policy.

Paul Brenton et al. (2009) analyze the impact of carbon footprints and carbon labeling on climate change and international trade, especially the potential impacts on small business owners and low-income countries. Carbon labeling is a useful supplement to other anti-pollution measures and it will play an important role in carbon emissions reduction. However, carbon labeling may harm fair trade, which especially affects low-income developing countries. G. Edwards-Jones et al. (2009) analyze the impacts of carbon labeling on the vulnerability of developing country horticultural exports to Great Britain. They observe that products that can be easily substituted and are produced far from Great Britain are most influenced, such as kidney beans from Kenya, tomatoes and chilies from Israel and peas from Guatemala, whereas tropical products or other products that cannot be easily substituted are rarely affected, such as tea and grapes from India, mangoes from the Philippines and tea from China. Many scholars believe that carbon labeling will significantly influence food trade (Jodie Keane et al., 2010) and it will likely become a new non-tariff barrier (James MacGreor, 2010) to food trade for developing countries (Alexander Kasterine and David Vanzetti, 2010). Thus, this issue deserves careful attention and intensive study. Yingfei Hu et al. (2010) argue that it is important to learn from developed country experiences when establishing China's carbon labeling system. Xiangzhao Feng et al. (2010) describe the carbon footprint accounting standards for British products, PAS 2050, and analyze their feasibility and suitability in China. Chuanmin Shuai et al. (2011a) review previous research on the development of carbon labeling and studies of its impact on agricultural trade as well as the impact of different emission reduction measures on trade (Chuanmin Shuai et al., 2011b).

2.3. The impact of carbon labeling on CO_2 emissions reduction

Geoffrey Beattie (2009) observes that both implicit and explicit consumer attitudes towards low-carbon products are positive, and the implicit attitude is more important than the explicit attitude within the same sample. This relationship implies that positive consumer awareness about carbon labeling is positively associated with low-carbon consumption. Paul Upham et al. (2011) conduct an experimental study on the carbon labeling awareness of the British public and observe that the purchase of 40 low-carbon goods per week lowers personal carbon emissions by 10%. Jerome K. et al. (2011), in their experimental study, observe that consumers are especially likely to buy carbon labeled products when these goods are relatively cheaper.

2.4. Consumer willingness to pay for low-carbon products

Adopting contingent valuation and comparison methodologies, Ruiyao Ying et al. (2012) explore consumer willingness to pay for low-carbon pork products. The results indicate that consumers are motivated both by self-interest and altruism because a significant reduction in their willingness to pay for low-carbon pork when they feel certain that low-carbon consumption favors only the environment and does not favor their own utility. Yingheng Zhou and Lifen Wu (2012) also examine the consumer willingness to pay for low-carbon pork and conduct an analysis of the factors that affect willingness to pay. The results indicate that the average willingness to pay for low-carbon pork is 3.95 yuan per kilogram, and willingness to pay is greatly influenced by factors such as low-carbon awareness, household income, family size and education level. Haifeng Liu et al. (2011) adopt the contingent valuation and investigation approaches to estimate Beijing residents' willingness to pay for low-carbon electricity by both mandatory and voluntary payments. The major factors are household income, family size, power consumption, bid value, participation in philanthropic activities and payment method.

Given the existing literature, we have compared previous studies with our study (see Table 1 for details).

Previous studies focus on the following issues: (1) theoretical analyses of carbon footprints and carbon labeling; (2) empirical studies of issues, such as carbon labeling of agricultural trade and CO_2 emissions reduction, in countries where carbon labeling schemes have already been implemented. Some researchers argue that the implementation of carbon labeling may become a barrier to international trade. They also argue that carbon labeling can promote the low-carbon consumption, which reduces carbon dioxide emissions. However, most of the previous studies examining willingness to pay for low-carbon products are not experimental studies; they usually acquire data from questionnaires.

Our study differs from previous studies in the following aspects: (1) This is a prospective study: we examine the willingness to pay for low-carbon products with carbon labels among Chinese consumers, a study conducted in a country in which carbon labeling has not yet been implemented; (2) This is an experimental study: we designed this study by scenario experiment and obtained primary data. We also conduct a quantitative analysis of the willingness to pay for low-carbon products of Chinese consumers and propose policy recommendations based on these findings. No other research of this type currently exists.

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