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Net private benefits of purchasing eco-labeled air conditioners and subsidization policies in China

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HIGHLIGHTS

- This paper analyses the net private benefits of purchasing eco-labeled air conditioners in China.
- There is no need to subsidize less energy-efficient air conditioners.
- The most recently proposed policy development in China is a reform headed in the right direction.

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ABSTRACT

Built on a data set of 527 air conditioner models collected from an online retailer, this study investigates whether the savings that consumers realize on their private electricity bills from purchasing energy-efficient appliances compensate for the additional cost of the appliances on the market, and if not, the size of the gap between the savings and the cost. Our findings show that, except for the most energy-efficient category, the cost savings from using energy-efficient air conditioners does compensate for their higher price. Therefore, any government subsidy should be reserved for the most efficient products. For less energy-efficient appliances, the best policy may be to provide more effective information instead of a subsidy because the subsidy might attract consumers away from more energy-efficient air conditioners and result in an unwanted effect.

1. Introduction

Residential electricity consumption in China, a subject previously neglected in the literature, now commands widespread attention from both policy makers and academia for two reasons. First, China's electricity consumption per capita has increased by an average of 11.03% every year during the last two decades (NBSC, 2012). More recently, the growth of residential electricity consumption has significantly outpaced industrial electricity use. For example, residential electricity consumption increased by 10.15% in 2012, while the growth of industrial electricity use was only about 4.12% (China National Energy Administration, 2013). Second, in spite of its rapid growth, residential electricity consumption only accounted for 12.03% of the total electricity consumption in China in 2011 (China National Energy Administration, 2012). Considering the fact that residential sectors consumed 37.94% of the total electricity generated in the U.S. (U.S. Energy Information Administration, 2012) and 24.47% in Europe (International Energy Agency, 2012) during that same year, as well as the ambitious goal of increasing personal income in China, we believe that residential electricity consumption will play an increasingly significant role in China's future.

One approach to curbing residential electricity consumption is to promote home appliances with higher energy-efficiency ratings. For this purpose, eco-labels that indicate energy efficiency, such as the China Energy Label, the U.S. Energy Star Label and the E.U. Energy Efficiency Label, are gaining popularity. These labels promise not only private benefits for consumers in the form of cost savings from reduced electricity consumption, but also public benefits in the form of reduced greenhouse gas emissions associated with reduced energy use. The hope is that publicizing the private and public benefits of more energy-efficient home appliances will attract consumers and in turn encourage producers to adopt more energy-efficient technologies.

Home appliances with higher energy-efficiency ratings are normally more expensive than those with lower efficiency ratings. To encourage the sale of more energy-efficient home appliances, government subsidies are often used together with energy labels. The rationale for subsidies is that the use of more energy-efficient

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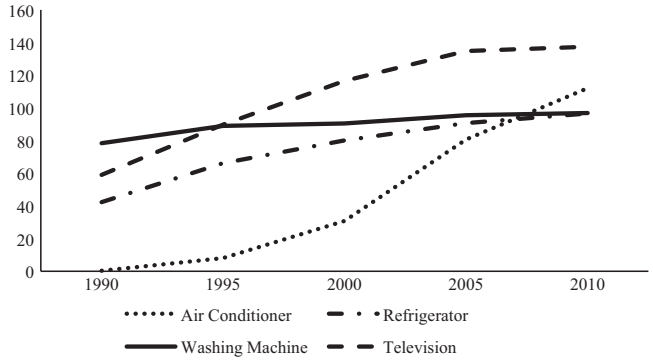

Fig. 1. The number of home appliances per 100 households.
Data source: National Bureau of Statistics of China.

home appliances produces positive environmental externality in the form of reduced carbon emissions, in addition to private savings on electricity bills.

However, a critical question that has not been answered sufficiently is whether the private benefit from electricity savings compensates for the additional price that consumers pay for energy-efficient appliances, and if not, what gaps need to be closed either by market interventions, such as stimulating consumers' willingness to pay (WTP) for public benefits, or by governmental policies, such as government subsidies. Our study attempts to address this two-part question – for the first time in the literature – because of its important policy implications. We argue that different answers to this question call for different policy instruments to stimulate consumers' willingness to buy energy-efficient home appliances. More specifically, if the private electricity savings from using energy-efficient appliances are not adequate to compensate for their higher prices, government subsidies might be warranted. If consumers' private savings are more than enough to cover the additional costs, disseminating information that improves consumer awareness of the benefits might be more appropriate. This question is particularly important for policy makers because inappropriate policy interventions would provide misplaced incentives in the market and induce an unwanted effect.

To answer this question, we focused on studying air conditioners. According to Zhang (2006), the use of air conditioners accounts for 34% of the total energy consumed by home appliances in China, and it is estimated that China will surpass the United States and become the largest user of electricity for air conditioning in the world by 2020 (Cox, 2012). Furthermore, the data from China's National Bureau of Statistics show that the average ownership of air conditioners per 100 urban households in China increased from 0.34% in 1990 to 112.07% in 2010 (NBSC, 2011). Fig. 1 shows that the increase in the use of air conditioners significantly outpaces that of other home appliances and this trend is likely to continue in the near future.

The Chinese government developed a subsidization policy based on the China Energy Label. Initially, it only applied to fixed-frequency[1] air conditioners with levels 1 and 2 of energy efficiency; later, it also covered convertible-frequency air conditioners (Fig. 2). The policy was suspended in 2013 and a proposed revision covers only air conditioners ranking among the top 10–15% in terms of energy efficiency. Reports indicate that sales of energy-efficient air conditioners dropped significantly immediately after the announcement of the policy change (AVC, 2013). A clear assessment and comparison of the private costs and benefits of using different models of air conditioners, which is the central task of this study, would provide important insights on whether these policy changes have been helpful and how policy should evolve in the future.

We collected data on 527 air conditioner models across 17 brands in April 2012, when no subsidization policy was in effect. We calculated both the additional price consumers needed to pay for more energy-efficient air conditioners and the electricity-bill savings they realized from using these air conditioners, taking the lowest energy-efficiency category as a reference point. We found that private savings do not compensate for the additional price only in the most energy-efficient air conditioners. There is actually a net private benefit to buy other categories of energy-efficient air conditioners.

This paper proceeds as follows. Section 2 provides some background on the China Energy Label program, and the subsidization policies based on this labeling system. A brief review of related literature is also presented along with a description of data and methods. Results are presented in Section 3. Section 4 provides some brief discussions on limitations of the study and future directions. Concluding remarks highlighting the policy implications of our study are offered in Section 5.

2. Material and methods

2.1. The development of the energy label in China

Many countries have used energy labels as a tool to promote products with higher energy efficiencies. For example, Australia and New Zealand developed energy rating labels, which is a type of energy input labeling and allows consumers to compare the energy efficiency between similar products. In Europe, EU Directive 92/75/EC, replaced later by Directive 2010/30/EU, established an energy consumption labeling scheme, which rated home appliances into seven classes and covered most home appliances including air conditioners, refrigerating appliances, washing machines, dishwashers, ovens and so on.

The Energy Conservation Law of China, published in 1997 and revised in 2007, stipulated that "producers or importers should attach energy-efficiency labels to products that are listed by the state in the product catalog of energy-efficiency management" (Article 19). This provides the legal basis for developing a mandatory energy-efficiency labeling system for home appliances.

On August 13, 2004, the National Development and Reform Commission (NDRC) and the State Administration for Quality Supervision, Inspection and Quarantine (AQSIQ) issued *Guidelines for Energy Efficiency Labeling Management* and created the China Energy Label. The Standardization Administration of China (SAC) was made responsible for managing the operation of the labeling system. The initial set of rules for energy-efficiency labeling was published in 2004 and first implemented in 2005 on two home appliance products: refrigerators and air conditioners. Five levels of energy efficiency were developed with level 1 indicating the highest level of energy efficiency, and level 5 the lowest. This system was revised in 2010 and Table 1 compares the old and new systems using data on fixed-frequency air conditioners as an example. It is clear that after 2010, the standards for energy efficiency were raised and products with energy-efficiency levels equal to 3 or lower – based on the old standards – are no longer allowed on the market. This policy is intended to keep pace with new advances in energy-efficiency technologies.

[1] According to the definition in the report, "Energy efficient room air conditioners – best available technology" provided by Topten International Services, a convertible air conditioner – "has a variable frequency drive which allows the air conditioner's compressor to run at part load and adapt its workload to the temperature change needed," while fixed frequency air conditioners "reach a certain temperature by switching from full load operation to off."