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Consumer myopia, imperfect competition and the energy efficiency gap: Evidence from the UK refrigerator market

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ABSTRACT

The empirical literature on the energy efficiency gap concentrates on demand inefficiencies in the energy-using durables markets and finds evidence that consumers underestimate future energy costs when purchasing a new appliance. We take a broader view and also consider the impact of imperfect competition. Using data on the UK refrigerator market (2002–2007), we find that the average energy consumption of appliances sold during this period was only 7.2% higher than what would have been observed under a scenario with a perfectly competitive market and non-myopic consumers. One reason for this small gap is that market power actually reduces energy use.

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1. Introduction

In energy and environmental policy circles, it is commonly believed that an "energy efficiency gap" exists between the desirable level of energy consumption and observed consumption (e.g. IEA 2007, Ryan et al., 2011). Since the seminal paper by Hausman (1979) and the discussion of possible policy implications by Jaffe and Stavins (1994), the energy efficiency gap has also attracted considerable interest in the academic literature (see the literature survey by Gillingham and Palmer (2014)).

To clarify the notion, it is necessary to distinguish two reasons that drive the gap between the actual and socially optimal levels of energy consumption. The first is the classic externality problem: the production and consumption of energy, in particular of fossil fuels, generate major environmental and health externalities which could be mitigated by policies promoting energy conservation. The energy efficiency gap refers to a second category of failures in the markets of energy-using durables. Energy efficiency outcomes involve decisions whereby consumers first make an upfront investment in durable goods and then consume energy through their use. Examples include water heaters, building insulation, motor vehicles and household appliances. The idea of the gap is rooted in a widespread belief that the market for energy-using durables does not operate effectively, i.e. markets are not perfectly competitive with fully rational economic agents. As a result, the market

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equilibrium maintains an energy efficiency gap defined as a wedge between the cost-minimizing level of energy efficiency and the level actually reached.

Policy discussions, as well as the academic literature, focus on the demand-side of the markets (IEA, 2007; Ryan et al., 2011; Allcott and Greenstone, 2012; Gillingham and Palmer, 2014). The key concern here is that imperfect information and other cognitive constraints could lead consumers to discard privately profitable investments.[1] More specifically, it is often asserted that consumers are myopic in the sense that they give too much weight to the upfront cost or, expressed differently, the discount rate implicitly used to calculate the net present value of the investment is too high. As a result, consumers use too much energy.

This is only half of the picture, however. On the supply side, manufacturers of energy-using durables also make decisions. In particular, they choose product characteristics and set the price at which products are sold. In the case of household appliances, they have a great deal of influence as these markets tend to be very concentrated. In 2011, Whirlpool Corporations, AB Electrolux, General Electric Company, and LG Electronics represented 90% of the sales of major household appliances in the US (Alegria et al., 2012). In the UK, competition on the refrigerator market is seemingly more intense as the top 5 companies represent around 46% of sales in our data for each year of the study period. However, product differentiation reduces competition as soon as we look at specific categories of products. For example, if we consider homogeneous segments of refrigerators or refrigerators-freezers that are either built-in or freestanding and of a specific energy efficiency class, the top 5 represent around 67% of sales in each segment.

In this paper, we consider both the role of potential consumer myopia and imperfect competition on energy consumption of refrigerators sold in the UK market. We use annual product-level panel data from 2002 to 2007 to analyze two types of decisions: consumer purchase decisions and suppliers' price-setting decisions. Next, we use our estimates to identify counterfactual scenarios with perfect competition and without consumer myopia. This gives us an estimate of the size of the energy efficiency gap which is defined in this paper as the difference between actual average energy consumption of sold appliances and the hypothetical consumption that would be observed in a perfectly competitive market with non-myopic consumers.

Our approach provides a more comprehensive measurement of the energy efficiency gap than that available in the literature. As mentioned above, existing works mostly concentrate on demand inefficiencies as illustrated by the recent reviews by Allcott and Greenstone (2012) and Gillingham and Palmer (2014). We go further, by examining the role of suppliers and imperfect competition.[2] We however limit ourselves to a study of the short-run equilibrium, where suppliers only choose prices, once product characteristics have been chosen. The impact of product innovation is left for future research. We also do not deal with all the imperfections that may influence energy use. In particular, we rule out any considerations related to the pricing of environmental externalities related to energy production and use or principal-agents problems[3] Our contribution to the relevant empirical literature is discussed in more detail in the next section.

Although there is no universal definition of the energy efficiency gap, we are aware that our definition is not the most common, as we depart from the view that limits the energy efficiency gap to consumer behavior. We are however not the only scholars who integrate supply-side inefficiencies as a cause of the wedge between actual and optimal energy use (for instance, see the papers by Jaffe and Stavins (1994) or Gerarden et al. (2015)). One could question the relevance of integrating both demand-side and supply-side inefficiencies in a unified framework instead of studying these imperfections separately. Such a global assessment is necessary if the purpose of measuring the energy efficiency gap is to identify and justify desirable policy intervention, a point made before us by Fischer (2005) and, more recently, by Gerarden et al. (2015) who stress the importance of supply-side factors when designing policies to promote energy-efficient household appliances. Take the example of the subsidies on energy-efficient goods that are recommended by some economists to mitigate demand inefficiencies (e.g. Allcott, Mullainathan and Taubinsky, 2014) and widely implemented in practice. If producers benefit from lower markups on energy-efficient goods than on less efficient ones – as is the case in the UK refrigerator market in this paper – then subsidies should be lower than they would be if prices were equal to marginal costs.[4]

We model demand using a standard discrete choice model with differentiated quality based on Berry (1994). We take the first-difference to eliminate time-invariant product attributes. A nested logit framework is used to control for product

[1] The nature of the underlying causes of demand inefficiencies is extensively discussed by Gillingham and Palmer (2014). Most of these causes are related to imperfect information. The simplest mechanism is when the decision-maker lacks information on the true benefits of energy efficiency investments. However, principal-agent problems can also arise when one party makes a decision related to energy use, and another party pays or benefits from that decision. For example, the landlord may pay for heating, while the tenant chooses how much energy to use. Another potential barrier is if the investor faces credit constraints that are stronger than for other investments because the lender finds it difficult to evaluate the payoff from energy-efficiency investments.

[2] The academic literature is reviewed in the subsequent section. Supply side aspects have been studied for instance by Fischer (2005), Jacobsen (2013), Houde (2014a, 2014b), and Goldberg (1998). In contrast with our paper, these studies do not seek to measure the size of the energy efficiency gap. Rather they evaluate specific policy scenarios (e.g. standards, feebates, energy labeling, etc.). A limited industrial organization literature has also examined the functioning of appliance markets (e.g. Ashenfelter et al., 2013; Spurlock, 2014).

[3] We also do not investigate how certain policies or regulations might alter the functioning of the markets. As an illustration, trade barriers may have hindered the imports of non-EU refrigerators during the study period. As appliances produced by well-known European brands tend to be more energy efficient than non-EU brands, removing barriers would increase energy use.

[4] Another option would be to adjust antitrust regulations, which is the primary policy tool to mitigate imperfect competition concerns. However this tool was not initially conceived for sector-specific adjustments.

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