[*IS OUR EVERYDAY COMFORT FOR SALE? – PREFERENCES FOR DEMAND MANAGEMENT ON THE ELECTRICITY MARKET*]

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Overview

It is fair to say that climate change and energy saving has been high on the political agenda for decades by now. In that context, a widely discussed approach has been energy efficiency and energy market transformation. Renewables, smart grids, smart meters, etc. are just examples of political catchwords in the strategies for future policies. In a European perspective, the electricity markets have been experiencing major changes via deregulation, new technologies and changes in the production mix. As an example, the share of wind and solar power has increased significantly while, at the same time, coal, oil and nuclear power have decreased. Together with the daily and seasonal peak hours on the demand side, the changing market puts pressure on increased flexibility to handle and sustain balance in the grid systems.

By focusing on the demand side it is tempting to say that energy efficiency and flexibility is just a matter of relative prices, price response and consumer response. In this context, the broad transition to real-time pricing is often highlighted as key to demand side flexibility in the electricity market. In addition to paving the way for dynamic pricing, the introduction of smart grids increase the opportunities for monitoring and evaluating household electricity use via e.g., so-called energy service companies, which may stimulate energy conservation. Moreover, the literature shows that just informing households about their electricity use relative to similar households may actually affect the behavior. This is related to the psychological literature on providing social norms to induce behavioral changes and energy conservation. The increased amount of information on household level may however also give rise to issues related to integrity and ethics.

As an alternative to traditional market mechanisms on the electricity market, it is not far away to think of a market with a more direct management of consumers during certain time periods such as e.g. peak hours and cold periods. Direct demand management would however impose large restrictions and potential disutility (discomfort) at the household level. Demand management could for example be illustrated by turning down the domestic heating system during cold periods, or by turning off the dishwasher during dinnertime to even out the demand for electricity. The direct and exact control of the demand side is attractive from a practical policy perspective since it is predictable and reduces uncertainty from a system perspective.

This paper focuses on demand management and it is natural to believe that it largely affect people's everyday life and comfort. From other studies it is known that the consumption of (demand for) electricity follows a pattern over time. Besides the seasonal patterns, there are peaks in the morning when everyone gets up and make breakfast, and in the evening when people turn on their stove, dishwasher, washing machine etc. Realistic scenarios of demand management would therefore imply turning off the dishwasher, domestic heating, etc. during certain hours, which, in turn, would affect people's utility and comfort. A potential result of more intermittent power production and a reduced capacity reserve is an increased probability of blackouts. The system needs to balance in all times, which may be more difficult with greater uncertainty. To implement demand management it is important to know about people's preferences. In practice, to sign an electricity contract including restrictions like the suggestions above, it is reasonable to think that consumers need to be compensated. How large does such compensation need to be?

Although there exist a literature related to electricity markets, smart meters, information, demand management etc., it lacks the explicit valuation of the utility change from a consumer perspective. This paper to some extent fills this gap and is highly policy relevant. From a political perspective it is crucial to know how much people expect in terms of compensation for, let's say, turning down the heating system by two degrees, or not being able to wash the dishes after dinnertime. In all cases, any policy reform needs to be tailored according to preferences to be credible and sustainable.

Methods

To address these kinds of questions, the paper is inspired by the non-market valuation literature. Specifically, the idea is to design hypothetical contracts characterized by potential scenarios in case of demand management to curb the peaks in demand. Still, it is important that the contracts are realistic and cognitive reasonable from the respondents perspective. By facing respondents with hypothetical contracts where they are supposed to choose the most preferred one, they implicitly reveal their preferences for the different attributes characterizing the contracts. In the literature the method is referred to as choice experiment, which is rather common and accepted. Besides the above-mentioned control of heating and household appliances, the integrity aspect is reflected in an attribute related to information about household electricity use. Finally, to make the experiment realistic, a monetary annual compensation is included, which also makes it possible to express preferences in terms of a monetary measure.

The data has been collected from almost one thousand Swedish citizens to represent the general public. The data has been analyzed within the discrete choice context and estimations are performed in the multinomial logit and random parameter logit framework. Moreover, to capture preference heterogeneity, extensive elaboration on socioeconomic factors and interaction effects are made.

Results

Not surprisingly, people in general perceive restrictions in energy use as something negative and therefore demand a compensation for acceptance. This is somewhat illustrated by the fact that 43-68 percent of choices are for the "status-quo" contract, and that 39 percent of the respondents choose status quo on all six choice questions. Regarding remotely controlling the domestic heating in the morning hours (7-10am) however, the compensation is not statistically significant. On the contrary, controlling the heating system during evening hours (5-8pm) implies a demand for a compensation of about SEK643 (€71). The explanation could be that people perceive a "delay effect" in the heating system, while also that people leave their homes for work, school, etc. during the day.

In general, the aversion is strongest against controlling the domestic electricity use (e.g. dishwasher, laundry machine, comfort floor heating). There is however a considerable difference in compensation between the morning and evening, SEK833 (€93) and SEK1409 (€157) respectively. Turning to limited electricity use during extreme situations, people demand about SEK44 (€5) per day of "preparedness". Finally, the results show that the sharing of information about energy use to other people (although anonymous) requires a compensation of about SEK243 (€27) annually.

To further elaborate on possible preference heterogeneity, several socioeconomic factors and other types of interaction effects have been included in the analysis. A first step is to explain the preference for a status quo contract (and a potential status quo bias). The focus has been on socioeconomic factors and it is found that the choice of status quo is positively related to age, income and living in apartment, while negatively related to university degree, stating "green" preferences and being politically active. Turning away from the analysis of the status quo effect, the results also include tests for possible interactions between the attributes and socioeconomic factors. Among other things, it is found that whether people are at home, household income, family composition, gender, heating system and age are, under certain circumstances, important factors explaining heterogeneity in preferences.

Conclusions

The future electricity market is challenged by deregulations, new technologies and changes in the production mix via e.g. intermittent production. One key to manage such challenges is demand side flexibility. It is found that the compensation needed to systematically "reschedule" and control the household electricity use is considerable and measures to about several hundreds of euros annually. Moreover, the "price" for demand flexibility largely depends on when, how and about what households we think of.