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Electricity Policy Research Group

Liquidity Constraints and High Electricity Use

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Philipp-Bastian Brutscher

The main question addressed in this paper is: why do some low-income households consume so much electricity?

The motivation of the research is the recent debate of a possible two-part tariff for electricity in Northern Ireland.

The idea of a two-part tariff is to provide a subsidized price for low levels of consumption with the subsidy cost recovered in the pricing of larger levels of consumption.

The underlying assumption of such a tariff is that low-income households typically consume less electricity than high-income households and so are likely to benefit from a two-part tariff.

While it is true that low-income households use less electricity than high-income households on average, there is a large part of low-income households with very high levels of electricity use. Specifically, ca 17% of households in Northern Ireland with an annual income below the median have a very high energy use. That is, their consumption lies in the top quartile of all household electricity use.

Understanding what drives this high electricity use is important for several reasons: First of all, it can tell us something about whether and to what extent low-income households can/will adapt to a change in the electricity tariff structure. Secondly, it allows us to find an optimal policy response (to the high electricity use of low-income households).

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Electric Heating and High Electricity Use

A simple regression of electricity use on a set of household characteristics – such as household demographics, household size, housing type and income level – suggests that the use of electric heating has a strong effect on electricity consumption.

We find that using electricity for heating is associated with an increase in electricity use by ca 210 KWh per quarter. This is equivalent to the average monthly consumption of a small household.

This – together with the finding that the use of electric heating is significantly more prevalent among low-income households – suggests that electric heating is an important driver of the high electricity use among low-income households.

Why do low-income households use electric heating?

There are several possible explanations why electric heating is so popular among low-income households. These include that low-income households:

- Tend to live in houses with electric central heating.
- Have no working central heating and so have to use electric fan heaters etc.
- Cannot afford purchasing heating oil up-front/in bulk.
- Find it more efficient to heat (parts of the house) with an electric heater.

In this paper, we focus on the third possible explanation – which is that electric heating is widely used among low-income households, because these households find it difficult to purchase heating oil upfront/in bulk.

The background is that ca 75% of dwellings in Northern Ireland (89% in rural areas) have an oil central heating and oil typically has to be purchased upfront and in bulk.

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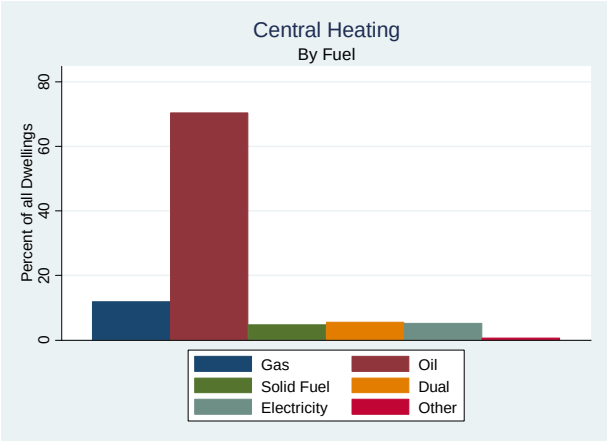

Figure 1 Central Heating by Fuel Type

We focus on this explanation, because it seems more plausible than explanations one and two: The figure above gives the distribution of dwellings across different types of central heating. It shows that only ca 5% of dwellings in Northern Ireland have an electricity central heating.

Similarly, in case of explanation two, ca 98% of dwellings in Northern Ireland have (some form of) cen-tral heating; only 1.3% of central heatings are defect – 88% of which are in non-occupied dwellings. This makes it unlikely that the widespread use of electricity for heating is due primarily to the absence of a working central heating system.

Liquidity Constraints and Winter Fuel Payment

One way of testing the role of a combination of liquidity constraints and a binding minimum purchase requirement for the high use of electric heating among low-income households, is to look at what happens if we give a random set of house-holds enough money to purchase heating oil (compared to a set of households which does not receive this money).

The underlying idea is: if low-income households use electricity for heating because they cannot afford to purchase heating oil upfront/in bulk, we should find that households switch from using electricity to oil as soon as they can afford doing so. That is, we should find that an increase in income leads to a jump up in the probability that households use oil and a jump down in the probability that households use electricity for heating.

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To test the effect of an increase in income, ideally, we would like to randomly allocate individuals into a treatment group and a control group. Individuals in the treatment group would receive £250 (which is slightly more than the average minimum purchase amount for oil) while individuals in the control group would receive nothing.

Because of the random allocation into treatment and control, we could be sure that whatever happens to the probabilities that households use oil/electricity for heating would be due to this payment. Luckily, we do not have to implement such an experiment: It turns out that the payment of 'Winter Fuel Payment' by the government provides a 'natural experiment'.

To see how a 'treatment effect' of receiving £250 can be identified from this payment, notice that:

- Winter Fuel Payment is allocated on the basis of age: households with at least one house-hold member age of 60 or over receive Winter Fuel Payment.
- Within a small interval around the cut-off age the allocation of Winter Fuel Payment is very similar to a randomised experiment. That is, because it is unlikely that there is something systematically different between people age 59 and 60, we can interpret individuals just above 60 as treatment group, while individuals just below the cut-off age as control group.

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Findings

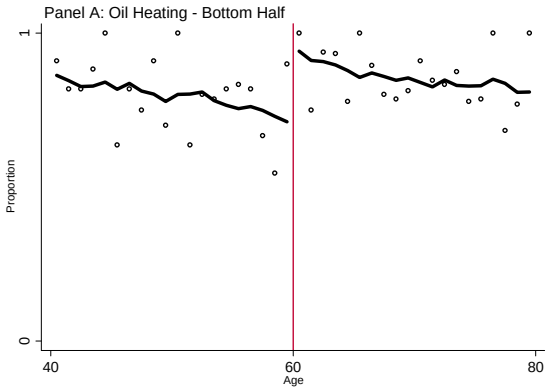

Figure 2a: Change Oil Heating

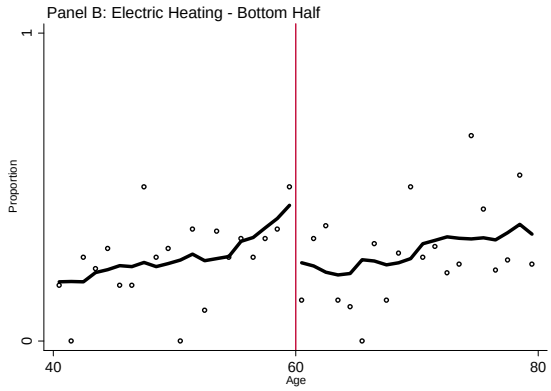

Figure 2b: Change in Electricity Heating

Figures 2a and 2b show the results from our analysis of the effect of Winter Fuel Payment. They show the effect on the probability of using oil/electricity for heating for a set of households with a household income of £20,000 or less.

The open circles can be interpreted as the probabilities of a household at a particular age to use oil/electricity for heating. The solid lines represent the best fit of a (local linear) regression through these circles. The vertical line marks age 60 (which is the age at which WFP is being paid). Households to the left of the vertical line do not receive Winter Fuel Payment, households to the right do.

A striking feature of the figure on the left is that the probability of a household to use oil as a heating fuel appears to be a continuous and smooth function of age every-where, except at the threshold that determines whether a household receives Winter Fuel Payment or not. There is a large discontinuous jump in the probability of a household to use oil to heat its home at age 60.

The size of the jump is relatively large and statistically significant: We find that a household that receives Winter Fuel Payment is ca 40 percentage points more likely to use oil as a heating fuel than a comparable household that does not. In the figure on the right, we plot the same relationship (as in the figure on the left) – but now for the probability that a household uses electricity for heating.

We find the mirror image to the figure on the left: The share of households using electricity as a heating fuel drops at age 60. The

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change is again statistically significant (albeit not as much as in the case of oil). This suggests that the evidence is in line with our hypothesis – which is that people use electricity for heating because they cannot afford to purchase heating oil.

Alternative Explanation: Capital Stock

So far, we have assumed that capital stock is fixed. That is, we have assumed that households are stuck with a particular type of central heating – which is oil – and have no way of switching to a different system.

To the extent that households do have the possibility to change their capital stock – e.g. by moving house or by buying a new central heating – a possible alternative explanation for the change in the probability of using oil/electricity for heating is that it reflects the decision to move house/get a new central heating at age 60 (rather than reduced liquidity constraints).

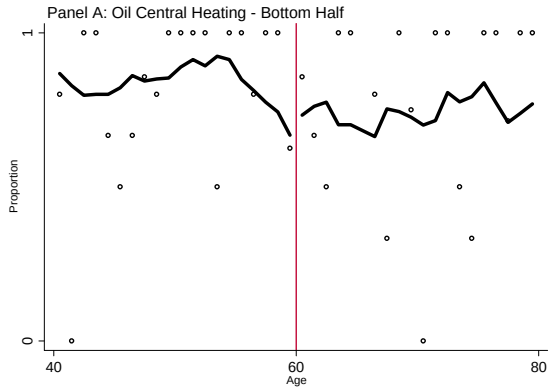

Figure 3a: Change in Oil Central Heating

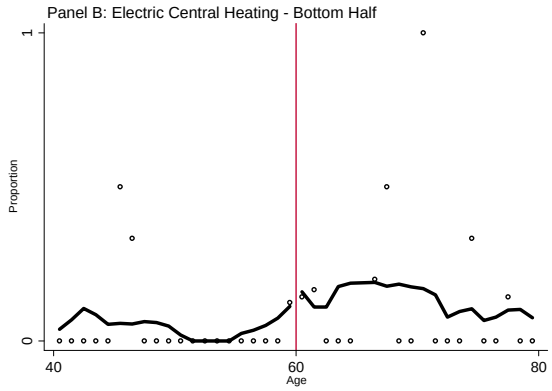

Figure 3b: Change in Electricity Central Heating

To test this possibility, we redo our analysis – this time looking at the probability of a household to have an oil/electricity central heating. The figures in the slide above show our results. They suggest no significant change in the probability of a household to have an oil or electricity central heating at the cut-off point.

This means that our assumption of taking capital stock as given is valid and that a change in capital stock does not drive our main findings.

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Alternative Explanation: Heating a Few Rooms Only

Another explanation for the increase (decrease) in the probability that a household uses oil (electricity) for heating is that Winter Fuel Payment allows households to heat more than one room/a few rooms.

To the extent that it is more efficient to heat a few rooms by means of electricity, while it is more effi-cient to heat several rooms by means of oil, a shift from heating a few rooms to heating several rooms would lead to a jump in the probability of using oil/electricity for heating (in line with the ones we observe).

One way of testing this explanation is by checking the effect of Winter Fuel Payment for households owning/renting a few rooms: If a household has a few rooms only, there should not come a point where it becomes more efficient to heat by means of oil. So receiving Winter Fuel Payment should not lead to a jump in the probability to use oil/electricity for these households.

If, on the other hand, households use electric heating, because they are liquidity constraint – we would expect that households owning/ renting a few rooms switch to oil heating as soon as they can afford doing so (just as households owning/renting several rooms).

What we find is that, in line with our liquidity constraint argument, the effect of Winter Fuel Payment on the probability of using oil/electricity for heating is the same for households owning/renting a few rooms as for households owning/renting several rooms.

Policy Implications

In this paper, we reviewed evidence which suggests that the high electricity use among low-income households is driven (at least in part) by the fact that a large part of these households finds it difficult to purchase heating oil upfront/in bulk and so has to use electricity to heat their homes.

This finding is relevant for at least two reasons:

- It suggests that low-income households will find it difficult to substitute away from electricity use after a change in tariff structure – resulting in higher bills under a two-part tariff.

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- In addition, it suggests that there might be other ways to reduce the electricity bills of low-income households – such as by helping them finance the purchase of heating oil.

Future research will look at the effectiveness of oil stamp programmes as used in parts of Northern Ireland in addressing the problem of liquidity constraints/a binding minimum purchase amount when it comes to purchasing heating oil.

Contact pbb24@cam.ac.uk
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