ADAPTATION TO CLIMATE CHANGE AND US RESIDENTIAL ENERGY USE – DOES ADAPTATION REDUCE GREENHOUSE GAS EMISSIONS?

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Overview

Whereas the climate agenda includes both the need for climate mitigation and climate adaptation, these two topics are usually considered as independent in political practice: mitigation policies focus on the decarbonisation of industry, agriculture and services, whereas adaptation measures consists in planning and carrying out necessary investments (e.g. dykes). However, climate adaptation will have an impact on GHG emissions, hence on climate mitigation. For the residential sector, previous literature has found that positive temperature shocks increase US residential electricity consumption. This suggests that climate change adaptation could increase GHG emissions from electricity consumption. This research goes beyond previous analyses by evaluating which drivers would explain the relationship between climate change and US residential energy use. We look at the alterations and improvements to housing associated with climate shocks – including but not limited to air-conditioning – and correlate these changes with both gas and electricity consumptions. Then resorting to a long-term simulation, we find that climate change is likely to increase residential electricity consumption. However, this surge in electricity consumption could be more than compensated by a parallel decrease in gas consumption. All in all, total energy consumption (adding gas and electricity consumptions) could decrease due to adaptation to climate change, but not necessarily greenhouse gas emissions. Electricity generation in the US is carbon-intensive so that the predicted shift from gas to electricity could sustain greenhouse gas emissions in spite of a total reduction in energy demand resulting from climate change. This puts pressure on decarbonising electricity generation.

Method

We analyse the impact of temperature shocks on residential energy consumption and carbon emissions. Importantly, we explicitly consider the mechanisms that explain the link between climate change and residential energy consumption. More precisely, we proceed in two steps. First we estimate how temperature shocks modify investments in dwellings (e.g. investments in air conditioning or insulation). We then assess the impact of the investments made by households on energy consumption and GHG emissions. Our research is based on micro-data from 14 biannual and national waves of the American Housing Survey (AHS, 1985-2011), which includes detailed information on the home improvements performed in a large panel of US homes. The data from the AHS has been matched with climate data from the National Oceanographic Atmospheric Association Data Center gathered for 159 localities in the US. Finally, we use the results of our econometric models of home improvement and energy consumption to perform a long run simulation of residential gas and electricity consumptions. Starting on year 2000, the simulation compares a baseline scenario with no climate change to a climate change scenario corresponding to a progressive increase in inland temperatures by 3°C in the 21st century. This increase in inland temperatures is equivalent to the RCP6.0 scenario of IPCC (2013), corresponding to a medium-high level of GHG emissions rejected into the atmosphere.

Results

Our econometric and simulation results confirm that households will adapt to climate change by purchasing more air-conditioners. This effect comes in addition to a more intensive use of already installed air conditioners and drives electricity consumption upwards (+7.7% by 2100 in the climate change scenario as compared with the baseline scenario in our simulations). However, the increase in electricity consumption could be compensated for by a reduction in gas demand (-13.4% by 2100 in our simulations), which is due both to a reduced use of gas heaters in winter and to a shift from gas to electric heaters in warmer regions. All in all, we find that energy demand decreases by 6.1% by 2100 as a result of climate change. The impact of the cut in energy consumption on emissions depends on the energy mix of power generation. Currently, electricity produces more GHG emissions than gas in the US. Therefore, the shift from gas demand towards electricity, as predicted by our model, would lead to a slight increase (+0.7% by 2100) of GHG emissions imputable to residential energy demand if today's facilities were used to produce electricity in 2100.

Conclusions

Our results gives a new reason for US policy-makers to insist on the decarbonisation of electricity generation, considering that household level adaptation is likely to favour electricity, both for space heating and air-conditioning. Moreover, our research suggests that the changes in residential energy consumption will be principally driven by the change in the composition of the major equipment installed by households, with more air-conditioners and electric heaters being installed. In our simulation, insulation would only play a minor role in compensating future electricity increases. Policy-makers may therefore need to encourage households to adapt to climate change by improving home insulation and inform them about the pressure put on electricity use by air-conditioners.

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