EKSH

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„Studying the effects of environmental policies using estimates from a household demand system"

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Dokumentation

The interaction between energy policies and the economic actions of private households is the focus of the doctoral dissertation. As a first step, I seek to understand the impact of taxes on households' consumption of energy goods, namely car fuels and electricity. In a second step, I seek to evaluate the outcomes of environmental policies along different dimensions including: (a) the effect on the demand for energy goods; (b) the effect on the environment, using e.g. CO_2 emissions reductions as measure; (c) the effect policy on the distribution of incomes (i.e. who will bear the monetary burden of the policy) and poverty.

Germany serves as my laboratory, and special focus is put on Schleswig-Holstein. Germany is one of the few countries which have a huge impact on the global energy policy. The International Energy Agency (IEA, 2007) stated that the country gave environmental issues top priority in policy making. However, according to the IEA, the country lacks integrated and coordinated environmental policy and the cost effectiveness of the renewables policies is questionable. Germany is thus an interesting case for examining the interplay between the environmental policies and the households. In particular, I am interested in exploring the regional differences in energy demand, as well as differences of the environmental policies effects among the different federal states.

The federal state Schleswig-Holstein is particularly interesting to analyze because it has been a pioneer in harnessing renewable energy, especially wind energy. As Schleswig-Holstein supplies energy for other states in Germany, policies for cogeneration from a variety of renewables and fossil fuel plants will be mandatory. Understanding the demand for energy by households is crucial for energy policy design and policy making. The households in this region can be affected by increased energy taxes and surcharge and determining the impact of such changes on households' welfare, poverty and emissions is essential.

Predicting the household energy consumption in this federal state could help in designing better energy and environmental policies, with the aim of decreasing CO_2 emission, and lowering the usage of fossil fuels in power generation. Adjustment of household energy consumption will keep Schleswig-Holstein on the path to meeting policy targets and set an example for the rest of the German federal states.

In the first paper, which is co-authored with my supervisor, we have evaluated the income and price elasticities of demand, with the help of Demographically-scaled Quadratic Almost Ideal Demand System (DQUAIDS). The elasticities provided by the demand system estimates are imperative as they determine the sign and the magnitude of demand response to specific policy change. The most important findings for Schleswig-Holstein are the following: electricity, other fuels and car fuels were all found to be necessity goods and price inelastic.

Households living in this state are far less price elastic for electricity consumption relative to other German states, but more price elastic for car-fuels consumption.

One of the extreme tax scenarios involves doubling of the energy tax on car-fuels. Consequently, households in Schleswig-Holstein respond with larger quaintly reductions than the rest of Germany. They also have on average larger CO_2 emissions reduction and have smaller welfare losses and inequality increases. The other extreme scenario involves reducing of the energy tax to zero. In this case, consumers in Schleswig-Holstein will have largest consumption and emissions increases. The tradeoff between environmental, welfare and inequality effects of the tax reforms was also investigated. Our estimates indicate the presence of an emissions–inequality and emissions–welfare trade-off: increasing the 2008 car fuels tax by 5 percent implies an emissions reduction of 0.9 percent, an increase in inequality of 0.04 percent (according to the Gini coefficient), and a considerable welfare reduction (according to the equivalent variation) for low-income households of 17 euros (0.12 percent of income).

The first paper was accepted and published in the journal of Resource and Energy Economics (Ranked B+ by the IFW) after 2 revisions and quite substantial work and time investment in the manuscript. The online version was available in March, 2016 and the paper version was published in May, 2016.

In the second paper, changes in the price of electricity were explored with the help of demand systems and price changes simulations. Both decreases and increase in the Renewable Energy Act Surcharge (EEG Umlage), which is an important part of final consumer's price for households, were considered. The purpose was to examine how income and energy poverty, and CO_2 emissions are influenced by the changes in the EEG surcharge. Households residing in Schleswig-Holstein react with smaller electricity quaintly increases and reductions than the rest of Germany.

The paper investigates two alternative policy scenarios: doubling of the EEG surcharge and abolishment of the EEG surcharge. Doubling of the surcharge increases the electricity tax burden for all income deciles but the increase is highest percentage of income for the poorest households. Both income and energy poverty would increase by 1.4 and 12 percent respectively while CO_2 emissions coming from electricity go down by around 9 percent. If the EEG is abolished, electricity related emissions would grow by around 6 percent. Energy poverty will decrease by 10.4 percent and income poverty will be 1.8 percent lower. The poorest household would benefit from elimination of the EEG surcharge also by having lower energy tax burdens. In addition, scenarios in which car fuels tax (CFT) was

changed together with the EEG surcharge are considered. When the CFT is also abolished, income and energy poverty are 7.2 percent and 65 percent lower respectively, and emissions increase by 12.3 percent.

The final paper deals with the topic of residential emissions inequalities in Germany. Using the Income and Expenditure Survey (EVS) data for the period 1993-2013, two types of emissions inequalities among German households are identified: i) intra-generational – a) poor versus rich and b) rural versus urban inequalities, and ii) intergenerational – birth cohort inequalities. The descriptive evidence demonstrates that the high income German households emit around 70 percent more CO_2 than low income households in 1993 and around 200 percent more in 2013. Also the gap between the rural and poor households' emissions has further widened in the past twenty years: from 11 percent in 1993 to 40 percent in 2013. An inverted u-shaped relationship is found between total energy related emissions and the birth cohort of the household's leader. The emissions are highest for the households that have a leader born between 1933 and 1963, and they emit on average 9 percent more CO_2 than the average German household, without taking age or period into account.

By applying a De-trended Age Period Cohort (APCD) model, I find that birth cohorts (groups of people who were born in the same year and consequently are expected to have similar behavior patterns) play important role in determining energy consumption and energy related pollution. The households with leaders born 1933-1973 (in 5 years intervals) are found to be the highest CO_2 emitters, while the cohorts born in 1913-1928 and 1978-1988 emit lower amounts of CO_2 in comparison to the average household. Adding additional controls to the model demonstrates that the generational effect is still present, statistically significant and might be a reflection of both large and energy inefficient infrastructures as well as higher number of motor vehicles used by earlier generations. The German households with leaders born 1943-1973 emit more CO_2 than their predecessors or followers, when holding everything else constant. The cohort effects of other household members on emissions are also examined. The cohort effects of the additional household members born between 1913 and 1988 are positive and statistically significant. Emissions are on average around 13 percent higher if the household has an additional household member, who belongs to the birth cohorts 1923, 1928, 1933, 1938, 1943, 1948, 1953, 1958, 1963 or 1968.

The financing of my PhD research by the EKSH gave me the chance to study residential energy demand in Schleswig-Holstein and the rest of the country. I had the

opportunity to investigate how price and tax changes of the energy goods influence consumer welfare, tax burdens, CO_2 emissions, income and energy poverty, and inequality among the German households. Higher energy taxes are associated with lower emissions levels but on the other hand inequality, poverty levels and tax burdens all increase. Empirical evidence is found for the existence of trade-offs between environmental goals and equality or poverty concerns. Also energy poverty among households has to be recognized as problem and policies should be designed which aim at reduction of fuel vulnerability. Furthermore, I was able to examine the inter- and intra-generational emissions inequalities in Germany. My results show that a pronounced generational effect persists even after controlling for relevant variables, with the cohorts born between 1943 and 1968 having a stronger tendency to emit energy related CO_2.

I am convinced that the results of my research project provide solid empirical evidence to policy makers and will help in designing improved energy policies in Schleswig-Holstein and Germany. The EKSH scholarship allowed me to attend some of the top ranked conferences, summer schools and workshops in the field of energy economics. I am deeply grateful that I was able to participate in such events, expand my energy knowledge, expertise and grow my professional network.