Households' CO2 missions, income inequality, and energy taxation: Evidence on the German car fuels tax

Dragana Nikodinoska and Carsten Schröder, *Resource and Energy Encomics*, Click here for access

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Context and Objectives

- Germany and many other countries impose consumption taxes on private household's consumption to reduce emissions.
- Here we study the implications of the German car fuels tax for (a) households' CO2 emissions, (b) post-tax income inequality, (c) and household material well-being.

Econometric Approach

Households' demands are not static. They respond to changes in income, prices (incl. consumption taxes), household compostion, etc.

$\Rightarrow$ Ignoring behavioral responses to price changes would give a biased assessment of tax incidence and emissions.

$\Rightarrow$ We are estimating a demographically-scaled quadratic almost ideal demand system (QUAIDS). It shows how commodity-specific demands vary with prices, income, and household composition. Amongst others, they respect adding-up.

Data

- Income and Expenditure Survey (IES) for Germany 1998ff
  - Provider: Federal Statistical Office
  - Survey design: cross sectional, quota sample (not random $\rightarrow$ risk of selection bias)
  - Availability: every 5th year
  - Sample size: 50-60k households
  - Variable spectrum: all types of consumption (aggregate and disaggregate levels), socio-economic and demographic characteristics, income and other revenues, paid taxes and contributions, inventories, and wealth (accumulation)
- Commodity-specific prices 1998ff
- CO2 conversion factors of cares fuels

Results

- In the status quo (tax rate: 60.6 cents per litre; expenditures from IES 2008), total car fuels-related emissions of German households are 77.6 megatons (Mt), and the Gini of post-tax income is 0.266 percent.
- Demand for car fuels is price inelastic: 1 percent price increase lowers demand by 0.08 percent.

Results

- Simulation of a tax rate increase by 50 percent ...
  - decreases emissions by 8.25 percent
  - increases the post-tax income Gini index by 0.27 percent.
  - decreases aggregate monetary welfare by 11.51 (10.7) billion euros, as measured by the aggregate sum of equivalent variation, $EV^{agg} = \sum_i e_i(p^1, u^1) - e_i(p^0, u^1)$.

  $\Rightarrow$ Emissions–inequality and emissions–welfare trade-offs

Follow-up meta study

N Ohlendorf, M Jakob, JC Minx, C Schröder, JC Steckel (2021): Distributional impacts of carbon pricing: A meta-analysis, *Environmental Economics*
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Which consumption aggregates did we use?

1. Overall household expenditures
2. Sub-aggregates: food, electricity, other fuels, car fuels, others (residual)
3. Other variables: disposable income; number and age of household members; regional context information; frequency weights.

Exercise required complementary data: commodity prices, institutional infos about the car fuels tax, CO2 conversionf factors,

Cross-country comparability and social transfers in kind

- Doing the exercise cross-country would be great, but ... high requirements on data, comparability of data across countries, and institutional knowledge (see above). That is why we resorted to meta-study design.
- Having information on transfers is important in our context: the German welfare system covers part of rent burden incl. heat/electricity costs $\Rightarrow$ Reported expenditures for transfer recipient is close to zero, but they consume and cause emissions.

Like to see included in LCS (and the IES)

- Prices: necessary for estimation of elasticities, computation of consumption levels, etc. (but lacking in IES)
- Quality / technical information (e.g., cm^3 of a car's engine or housing characteristics (size, endowment, insulation of housing))
- Inventories: for duarables
- Information on who consumes what in the household (joint consumption, within-household public goods)
- Regional identifiers (e.g., for linkage with public transportation infrastructures or air quality (pollution))
- Information on survey / accounting periods
- Information on imputation (methods and imputation flags)

The accounting period issue

Assume that true expenditures in a 4-household economy across quarters is:

$$\begin{pmatrix} 100 & 0 & 0 & 0 \\ 0 & 75 & 0 & 0 \\ 0 & 0 & 50 & 0 \\ 0 & 0 & 0 & 25 \end{pmatrix}$$

The accounting period issue

Accounting period last **12** months: "Over the last 12 months, how much money did you spend on ... ?"

$$\begin{pmatrix} 100 \\ 75 \\ 50 \\ 25 \end{pmatrix}$$

The accounting period issue

Accounting period last **3** months (and field phase is in **April**): "Over the last 3 months, how much money did you spend on ... ?"

$$\begin{pmatrix} 100 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

The accounting period issue

Accounting period last **3** months (and field phase is in **July**): "Over the last 3 months, how much money did you spend on ... ?"

$$\begin{pmatrix} 0 \\ 75 \\ 0 \\ 0 \end{pmatrix}$$

$\Rightarrow$ **I have no easy fix for this issue (and it gets worse if you think about seasonal patterns). At least, differences in accounting periods require very good documentation.**

Imputation

From the side of the user, having imputed micro data is convenient, but ...
... the imputation of expenditures is not a trivial task

1. Availability of key explanatory variables for imputation might differ across countries
2. In general, explanatory power of demand estimations is low $\Rightarrow$ a lot of noise, particularly in the case of durables (incl. housing)
3. Adding up must be secured (Y=Ex+S).
4. Some studies provide imputed expenditures (but no imputation flag).

$\Rightarrow$ **Implementing a consistent imputation across countries is a challenge. Good documentation and user training is essential!**

Concluding remark

- I applaude the initative – fills an important gap in cross-country data infrastructures.
- Don't try to do everything at the same time.
- Prioritize data products which are most interesting to your core group.[1]
- Provide the raw micro data and data-preparation documentations (replication codes).

[1] As an example, adding information on the role of privately-purchased and publicly provided goods (who pays and who benefits?) is certainly interesting. However, doing it properly requires extensive knowledge about: exact formulations and definitions in the surveys, whether respondents understand all the details, country (county) institutions, etc.