Final_Paper

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Introduction and Motivation

Climate change is undoubtedly a global problem, but this fact means it is also, in a way, a classic tragedy of the commons. No country wants to put itself at an economic disadvantage by restricting the use of cheap fossil fuels so all continue to emit, deteriorating the "commons" of the Earth's protective atmosphere. This can make it difficult to get citizens to identify with the problem and take responsibility; people will more likely act when something affects them individually. In this paper we want to explore this aspect: how much do people feel, consciously or unconsciously, the effects of green house gas emissions? More specifically, do emissions affect their reported health, well-being, or life satisfaction?

Insert more info about Green Growth theory

Literature Review

In recent years, there has been a large body of empirical literature on the happiness of individuals and the effects of climate and pollution variables. In general, the findings highlight the importance of environmental conditions on individual's happiness. A significant share of the studies find a negative correlation between pollution or negative environmental conditions and overall life satisfaction, or happiness.

Welsch (2002) published an initial happiness-related study on how self-reported well-being fluctuates with different levels of prosperity and environmental quality. The study used cross-sectional data on 54 countries to illustrate how individuals are willing to calculate the trade-off between wealth and environmental conditions (Welsch 2002). The study found a negative effect of poor air quality on overall happiness of individuals, however was unable to control for heterogeneity across countries as the analysis was conducted on an aggregate level (Welsch 2002; Goetzke and Rave 2015). Welsch (2006) used a combined cross-section time-series framework to address this problem with annual data for 10 European countries from 1990-1997. By using this panel method, he was able to use country-fixed effects to eliminate problems of unobserved heterogeneity across countries. In this more robust study, Welsch (2006) finds that air pollution has a statistically significant function in predicting inter-temporal and inter-country differences in levels of happiness.

Rehdanz and Maddison (2008) used the SOEP (German Socio-Economic Panel) surveys to analyze the relationship between perceived noise and air pollution, and self-reported well-being in Germany. The evidence suggests that even when controlling for a range of variables such as demographic differences, economic status and neighborhood individualities, higher levels of noise and air pollution reduce overall levels of happiness (Rehdanz and Maddison 2008). Similarly, Brereton, Clinch, and Ferreira (2008) conducted a similar study in Ireland using data at the individual level and found that overall climate conditions had a statistically significant influence on individual happiness. The study found that proximity to waste facilities and transport routes was highly relevant in explaining the variation in happiness levels.

MacKerron and Mourato (2009) conducted a case study on London focusing on Nitrous Oxide pollutants, and the willingness of inhabitants to pay for various levels of air quality. The study collected pollutant concentrations in the immediate proximity to residents' homes, and found that both subjective perception of air quality and scientific measurements of air quality both had negative statistically significant impacts on self-reported happiness levels (MacKerron and Mourato 2009). Luechinger (2009) and Ferrer-i-Carbonell and Gowdy (2007) find similar results in their individual-data country-level analyses. Luechinger (2009) estimates the effect of SO2 concentration on life satisfaction in residents in Germany using pollution data and the SOEP data. In order to control for simultaneity between air quality, economic downturns, and declining industrial production, Luechinger (2009) uses the estimated improvement in air quality caused by

mandated power plant scrubbers as an instrumental variable (IV). The study finds that IV-estimates produce larger negative statistically significant impacts of pollution on happiness. Ferrer-i-Carbonell and Gowdy (2007) study the relationship between well-being and individual environmental attitudes. The authors use a probit model to study the relationships with specific focus on ozone pollution and species extinction using the British Household Panel Survey and find a negative correlation of ozone pollution on individual's well being (Ferrer-i-Carbonell and Gowdy 2007). The study finds that the correlations are constant even when controlling for pollution conditions, engagement in outdoor activities and regional conditions.

In another study, Menz and Welsch (2010) further estimate the effect of air pollution on life satisfaction using 25 OECD countries and the World Database of Happiness between 1990 and 2004. The study finds that, using particulate matter concentration as a proxy for overall pollution levels, the correlation between overall happiness and pollution levels is negative. Further, Menz and Welsch (2010) find that the effects are greater in older and younger individuals, and less significant for middle-aged individuals.

Cuñado and Gracia (2013) use Spanish regions to further explore the relationship between pollution, climate and subjective happiness. The authors use the European Social Survey to provide information on individual well-being, and data on pollution and climate data from the regional ministries and agencies. By controlling for socio-economic variables that potentially affect happiness levels, Cuñado and Gracia (2013) find that there are significant regional differences in happiness levels which can be explained by the role of climate and pollution variables. The results illustrate that environmental variables better explain regional differences in happiness than socio-economic regional variables.

Most recently, Goetzke and Rave (2015) expand on the ideas of Van Praag and Baarsma (2005), MacKerron and Mourato (2009) and Ferreira and Moro (2010) to account for the endogeneity problem between perceived air pollution and happiness. The endogeneity inherent in this analysis is that individuals bothered by air pollution are less happy, but simultaneously that unhappy people are more disturbed by air pollution (Goetzke and Rave 2015). Using the German socio-economic panel data along with annual sulfur dioxide readings, Goetzke and Rave (2015) analyze the impact of air pollution on happiness in Germany based on both the subjective perceptions of pollution and the objectively measured environmental conditions. Using the IV-ordered probit model developed by Rivers and Vuong (1988), they find in controlling for simultaneity that perceived environmental conditions do not have a statistically significant effect on happiness (Goetzke and Rave 2015).

Hypotheses

Germany is a leader in protecting the environment while also having a long history as an industrial power and coal producer. One one hand, its energy transition (*Energiewende*) is considered one of the most ambitious climate policy projects in the world. On the other hand, it has struggled with appropriate incentives, a drop in oil prices—not to mention coal's continued role as a cheap and reliable fuel—and how to transform the transportation sector. Germany therefore still does emit large amounts of green house gases. We will look at green house gas emissions data by federal state (*Bundesland*) and compare that with life satisfaction data to examine our first hypothesis:

> *H1: Bundeslaender with higher emissions inversely affect reported levels of life satisfaction.*

On the other hand, it may not be the emissions themselves that affect people's life satisfaction. People who are more concerned about the environment would be more concerned with emissions and may feel less satisfied with life than those who are less concerned about the environment. Therefore our second hypothesis is:

> *H2: Reported individual concerns with the environment are, likewise, negatively reflected in the life satisfaction.*

Data

The individual-level data is provided by the German Socio-Economic Panel Data GSOEP conducted by the German Institute for Economic Research DIW. Due to confidentiality restrictions, DIW could only supply a shortened sample with prior specified variables in a *.dta* format. Therefore, the GSOEP dataset is stored on the local drives and GitHub Climate-Happiness Repository. The original GSOEP file is cleaned and transformed into a shorter dataset with the help of the Stata Do-File. The short dataset contains the information on the main satisfaction and personal characteristic variables: reported levels of life satisfaction (on a scale from 0 to 10), subjective concerns about the environment, age, gender, employment, family status, and state residence of a respondent. Detailed labels and descriptions of the variables are given in the GSOEP codebook. All GSOEP-related files are stored on the GitHub server.

The state-level data, on the other hand, is gathered from three web-based sources: State Initiative for Core Indicators LIKI, Statista.com, Environmental-Economic Accounting of the Bundeslaender UGRdL and Agency for Renewable Agency of North Rhine-Westphalia AfEE.

A university subscription to *Statista.com* enabled access to historic state emissions from 1990 to 2012 for most of the Bundeslaender, except North Rhine-Westphalia (NRW). Since the website allows data downloads only in *Excel* and provides no unique URLs for each of them, 15 individual files were downloaded manually on a local machine, while manipulations were conducted with the help of R loops. The information on NRW involved more intensive research and data handling but were finally gathered and combined from the UGRdL (from 1990 to 2000) and *AfEE* (from 2000 to 2012) with R web-scraping functions. Fortunately, emissions are measured in the same units (annually emitted Carbon dioxide tons per capita). Hence, the yielded data frame of emissions is comprehensive and consistent, although there are missing observations on some years.

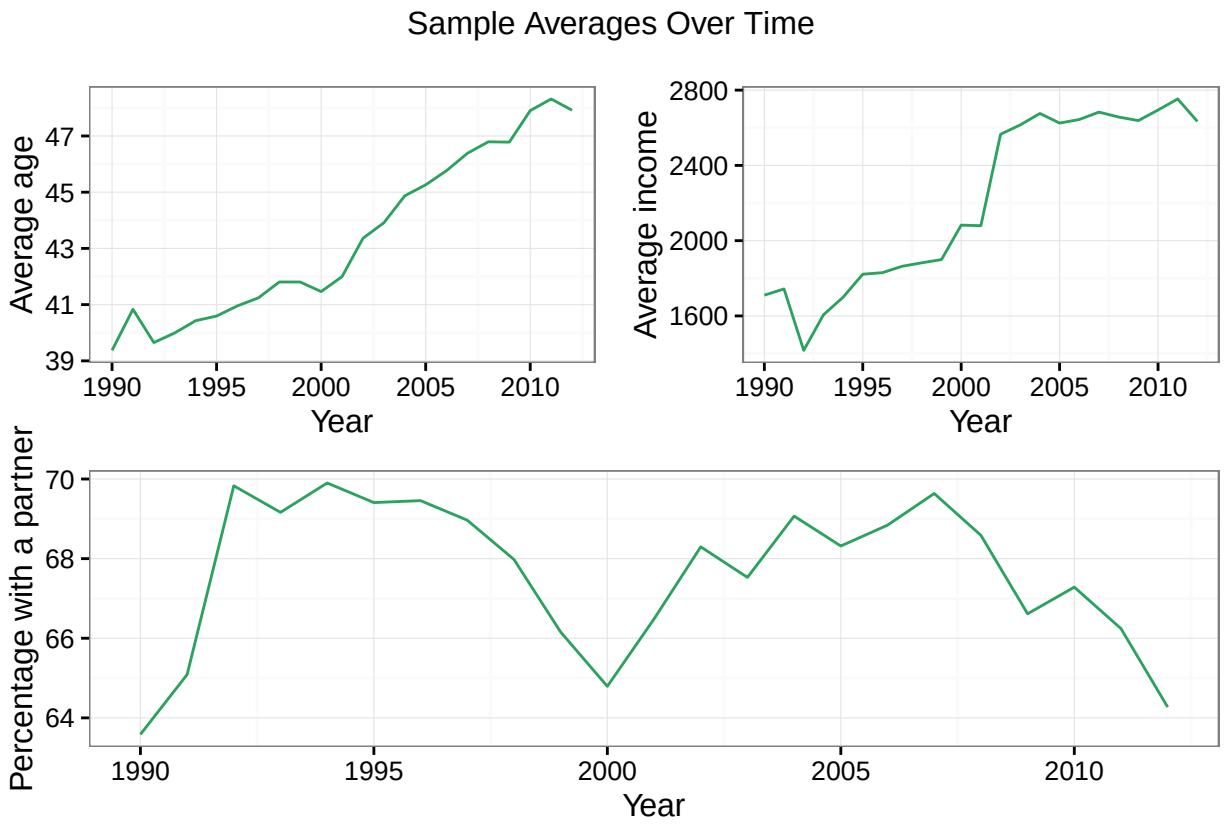
Simultaneously, the state efforts to curb their emissions and preserve local environment are reflected in their renewable energy indicators. This information is measured in percentage of renewables in the annual primary energy consumption, final energy consumption, and electricity consumption. The indicators had to be downloaded manually from *LIKI* in three separate excel files, which later on were cleaned, transformed and reshaped into suitable data frames in R.

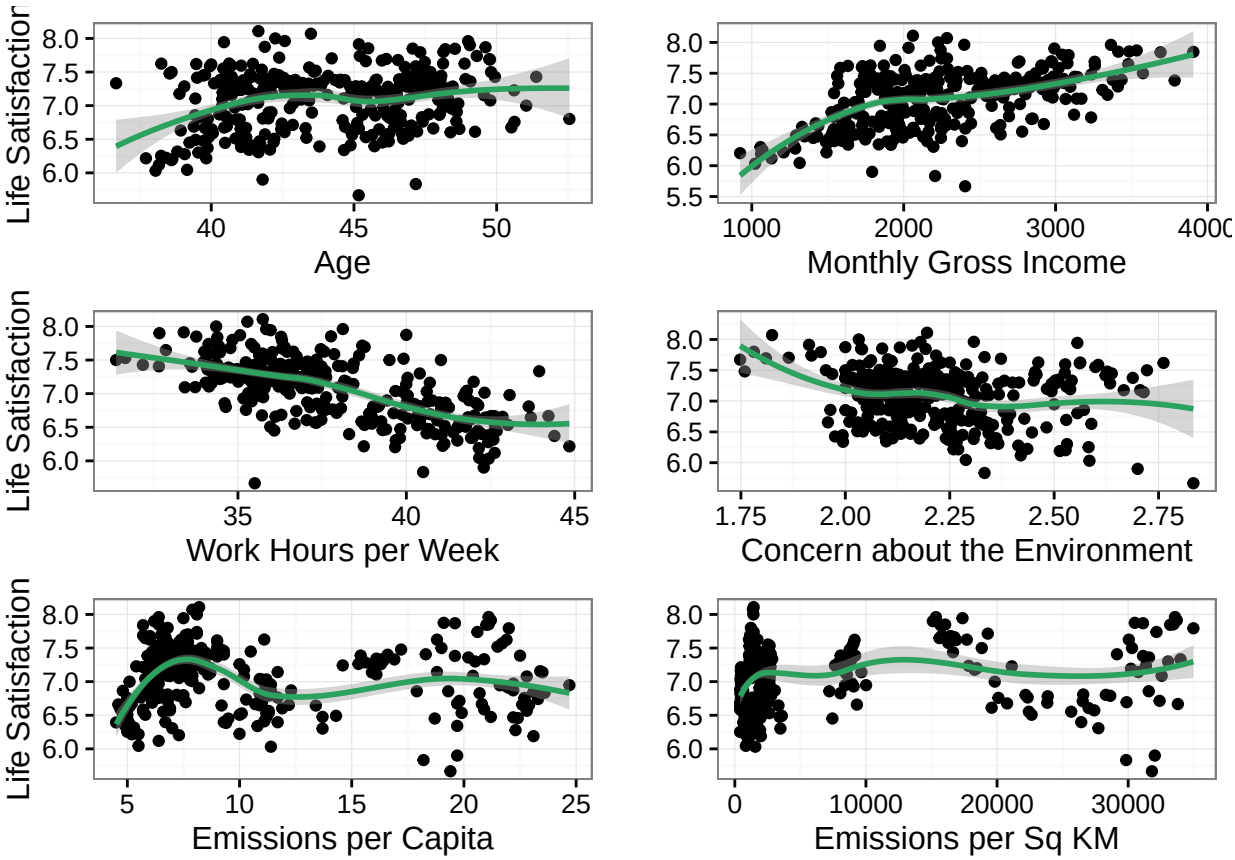
Once the names of the Bundeslaender and the time frame of the three produced data frames match, they are easily merged in R into a final data set.

% latex table generated in R 3.2.3 by xtable 1.8-2 package % Thu May 12 15:22:24 2016

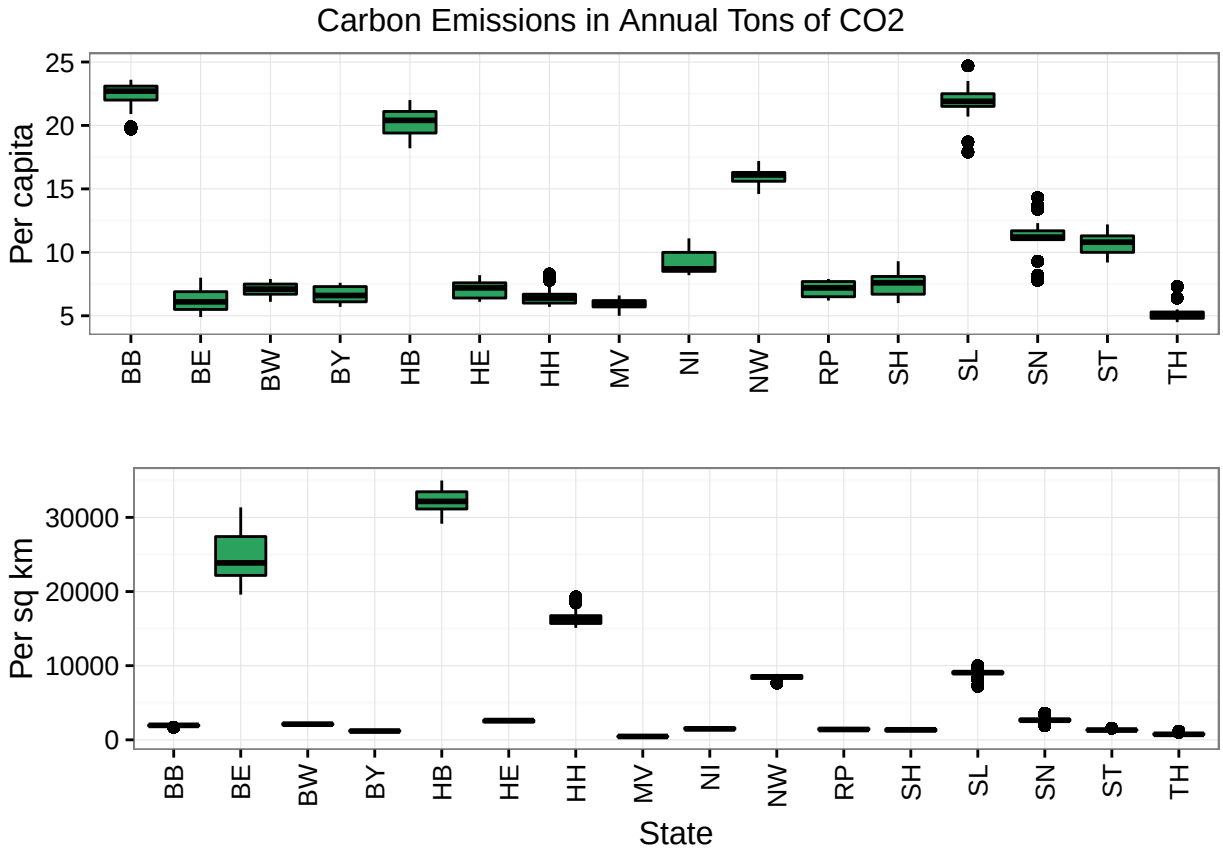
	Variables	Descriptions
1	Year	Year
2	State	State
3	WorkHours	Hours worked per week
4	GrossIncome	Gross monthly income (before taxes)
5	NetIncome	Net monthly income (after taxes)
6	GermanBorn	Born in Germany (1 if yes, 2 if no)
7	satis_labels	Life satisfaction, labeled on a scale of 1 (low) to 10 (high)
8	satis	Life satisfaction, numeric values (1-10) only
9	environ	Concern about the environment on a scale from 1 (not concerned at all) to 3 (very concerned)
10	gender	Gender
11	age	Age
12	emp	Employment status (1 if not employed, 2 if employed)
13	fam	Family status (1 if single, 2 if with a partner)
14	CO2Tons	Total tons of CO2 emitted in each state, in 1000 tons
15	sqkm	State area in square kilometers
16	CO2perSqKm	Tons of CO2 emitted per square kilometer for each state
17	Emissions	Tons of CO2 emitted per capita in each state

Individual descriptive statistics




Life Satisfaction
8.0
7.5
7.0
6.5
6.0
40
45
50
Age
5.5
1000
2000
3000
4000
Monthly Gross Income
35
40
45
Work Hours per Week
1.75
2.00
2.25
2.50
2.75
Concern about the Environment
5
10
15
20
25
Emissions per Capita
0
10000
20000
30000
Emissions per Sq KM

State level descriptive statistics



Methodology

The analysis will focus on a mixture of two levels of interest: *Federal State*, e.g. reported emissions and *the individual*, e.g. the socioeconomic status of the respondent, gender, and age. In order to account for such clustering and track differences between the German States, multilevel modelling will be applied in this project. Multilevel modelling aims to identify and understand the variance among groups and identify sources of non-independence in the data *Bliese2013 - add to bibliography.* This approach, unlike the traditional multivariate regression, partitions the residual variance into a between-state component (the variance of the state-level residuals) and a within-state component (the variance of the individual-level residuals). It does so by first finding the differences in the intercepts of groups on the dependent variable and then finding the variations in the slopes across groups (the between variance) and within a group (the within variance). Such grouping will produce more robust and reliable results, which could be potentially inferred to a larger population. Therefore, multilevel modelling is preferred over a fixed effects model, which cannot separate out effects due to observed and unobserved characteristics. *Include?:* In addition, the model can be extended by exploring the temporal effects and overtime change in the individual and state level attitudes. Time-varying components of the model, consequently, will be possible to track.

Analysis

Discussion

This paper presents a multilevel analysis that adds to the increasing number of studies that evaluate the effects of air pollution and emissions on people's life satisfaction. In fact, in our data the potential negative impacts on happiness associated with emissions levels was non-existent when we controlled for state-level and individual characteristics. We approached the problem of estimating the reduction in satisfaction by examining a number of regressions based on life-satisfaction that include a variety of socio-economic data to justify a person's stated level of life satisfaction on a subjective 1-10 scale.

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