Research Proposal: Do emissions affect life satisfaction?

Katie Levesque, Meerim Ruslanova, Sarah Unbehaun

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Introduction

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?

To examine this question, we will look at data from Germany. 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 will have lower reported levels of health, well-being, or life satisfaction.*

We will also investigate whether there is a time component to perceptions of life satisfaction and well-being. Germany's emissions have been reduced since 1990, though reductions have stagnated recently. Using data going back to 1990, and again using emissions as the independent variable of primary interest, our second hypothesis is:

> *H2: Reported levels of health, well-being or life satisfaction will reflect changes in emissions in line with hypothesis above, i.e. as emissions decline, reported levels of health, well-being, and life satisfaction will rise.*

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 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) use the estimated improvement in air quality caused by mandated power plant scrubbers as an instrumental variable. The study finds that IV-estimates (instrumental variable) 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).

Data

The data for the project will be supplied by a combination of sources. The first layer of the analysis builds on the individual-level data taken from the longitudinal German Socio Economic Panel (GSOEP) from 1984 to 2013. The German Institute for Economic Research (DIW Berlin) supplied the main GSOEP dataset, though reduced in size due to the data restrictions and confidentiality. The variables included in the dataset cover subjective life satisfaction, gender, age, family status, education, employment, income, health, and environmental perception of the respondents across the German federal states. All the names of the variables are available in the GSOEP codebook. The number of the observations in the original dta file is 192,841.

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Another alternative source for the information could be the Statista Database that distinguishes information on state emissions for the same time period, but in a table format. An example of the Statista webpage can be found here.

The dependent variables of interest is the self-reported level of life satisfaction, which is measured on a scale from 0 to 10 (lowest to highest levels). There are several measurements of the happiness level, including the present state of the respondent, the past, and the anticipated levels of life satisfaction. Moreover, the dataset provides information on individual perception about the environment and recent developments in the issue. Likewise, the health status is also based on individual self-reports. Since the analysis will rely on these self-reported variables, the model is prone to a subjective bias created by the individual perceptions.

The second layer of the analysis requires data on GHG emissions by the Federal State. While the data on country-level is widely available, the information per state is limited, especially in a user-friendly format. The report conducted by the German Environmental Agency has the necessary indicators on overall state GHG emissions from 1990 to 2012 in a PDF format, which could be transformed for the project (Umweltbundesamt 2014). The emissions are measured in Gg carbon dioxide per year as reported by the Federal States and are available in *Table 16: Comparison of the results of CO2 calculations of individual LÃ¤nder with corresponding figures from the federal inventories*. The Table 16 also provides the deviations between the self-reported values and the federal estimations.

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Other state indicators, such as per capita emissions from primary energy consumption and air quality, are available from 1995 to 2012 at the Working Group on Environmental-Economic Accounting of the LÃ¤nder. Although these numbers are listed in a convenient table and would be a better match for the individual levels of happiness, the data is cross-sectional for each five years, which leaves gaps for other variables.

Evidently, there are several options for the data sources. The final model used for the analysis will determine the specific information type for GHG emissions, the necessary format, and the data frame. The minimum starting year of the analysis will have to be later than 1990 after the German reunification.

Methodology

The analysis will focus on a mixture of two levels of interest: *the individual* - e.g. the socioeconomic status of the respondent, gender, age, and the *Federal State* - e.g. reported emissions and perceived of air quality. In order to account for such clustering and track differences between the German States, multilevel modelling will be applied in this project. Given approach, unlike the traditional multivariate regression, will partition 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). 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 observes and unobserved characteristics.

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