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Analysis

Life satisfaction and air quality in Europe

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ABSTRACT

Concerns for environmental quality and its impact on people's welfare are fundamental arguments for the adoption of environmental legislation in most countries. In this paper, we analyze the relationship between air quality and subjective well-being in Europe. We use a unique dataset that merges three waves of the European Social Survey with a new dataset on environmental quality including SO_2 concentrations and climate in Europe at the regional level. We find a robust negative impact of SO_2 concentrations on self-reported life satisfaction.

1. Introduction

Concerns for environmental quality and its impact on people's welfare date back, at least, to the industrial revolution. However, conventional welfare measures, Gross Domestic Product (GDP) in particular, ignore many important non-market factors that may explain individual well-being, including environmental quality. In recent years, a broader perspective towards the measurement of welfare is emerging among economists (e.g., Deaton, 2008; Fleurbaey, 2009). Two manifestations of this broader perspective have been an increased interest in using people's subjective well-being as a proxy for utility, and hence a welfare indicator, and the consideration of a rich spectrum of factors (in addition to income) to explain people's well-being.

In economics, the interest in subjective well-being (often measured using "happiness" or "life satisfaction" questions) has increased rapidly over the last decade (for overviews see, e.g., Dolan et al., 2008; Frey and Stutzer, 2002; MacKerron, 2012; van Praag and Ferrer-i-Carbonell, 2008).[1] This new line of research has shown that many factors beyond income significantly affect people's subjective well-being, including health, employment, and marital status. The effect of environmental quality on subjective well-being has also begun to be investigated (for a comprehensive summary see Welsch, 2007, 2009; Welsch and Kühling, 2009). Research shows that several

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[1] Both happiness and life satisfaction are components of subjective well-being. Although slightly different constructs, economists often use them interchangeably to measure overall feelings of well-being. For a discussion on different question modes on subjective well-being and validity see, e.g., Kahneman and Krueger (2006).

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dimensions of environmental quality: noise (Van Praag and Baarsma, 2005), climate (e.g., Rehdanz and Maddison, 2005) and natural hazards (Luechinger and Raschky, 2009), have a significant influence on subjective well-being in the expected direction.

There are a number of papers analyzing the relationship between air pollution and subjective well-being. A common challenge to these papers is that to obtain high quality data on air pollution with detailed spatial disaggregation and link these to a specific individual is almost an impossible task. Unlike for other individual characteristics that might influence people's subjective well-being, information on environmental characteristics is typically not collected in the survey instrument and thus cannot be matched with respondents at the household level. For example, Rehdanz and Maddison (2008), using German data find that the *self-reported* adverse impact of air pollution and subjective well-being are negatively correlated. However, they do not use actual pollution indicators.

A number of early papers use cross-section and panel data where measured air quality for several pollutants is collected at the country level (e.g., Welsch, 2002; 2006; 2007). The overall findings are that air quality has a significant impact on people's subjective well-being. More recently, Luechinger (2010) investigates the relationship between SO_2 emissions at the country level and subjective well-being data in several European countries and finds a negative and robust relationship between the two variables.

Papers that use more spatially disaggregated pollution data have focused in one country. For example, Luechinger (2009) links SO_2 concentrations from monitoring stations in Germany to subjective well-being using data for almost two decades. He finds a significant negative impact of SO_2 pollution on well-being. Ferreira and Moro (2010) use regional data from Ireland with similar results for PM_{10}. Smyth et al. (2008) use pollution data in 30 cities in urban China, and also find a clear negative impact of SO_2 emission on subjective well-being. MacKerron and Mourato (2009) find that local nitrogen dioxide concentrations significantly reduce the life satisfaction of Londoners. Levinson (2012) uses an innovative approach by linking subjective well-being with air quality in the county or city where the respondent was surveyed at the day when the interview was conducted. He finds that higher levels of particulates are negatively correlated with well-being in the US.

Our study is the first multi-country analysis that uses spatially disaggregated data at the subnational level (regional data) on ambient air pollution concentrations (SO_2) coupled with other spatial controls (climate data on temperature and precipitation, and regional indicators of economic performance) to explain individual subjective well-being in Europe. We use survey data collected in the first three rounds of the European Social Survey (ESS)[2] between 2002 and 2007 matched with a uniquely created dataset on sulfur dioxide (SO_2) concentrations at the regional level (248 regions) in Europe. We use Geographic Information Systems (GIS) to interpolate annual mean pollutant concentrations for SO_2 from a network of monitoring stations in 23 European countries between 2002 and 2007, and match them (together with other spatial controls) with individual responses to the ESS during the same period.

A recent paper by Murray et al. (2011) considers the regional variation of climate across Europe and its impact on life satisfaction for the third wave of the European Values Survey. However, it does not consider air pollution, which, at least in the medium-run, is more amenable to policy intervention than climate.

Overall, our research feeds both into the recent development in subjective well-being research that considers environmental quality as a key determinant of subjective well-being as well as into a more policy-oriented interest in subjective well-being research.

Dolan et al. (2011) argue that subjective well-being data can be used in a number of ways by policymakers, and they highlight three areas: (i) monitoring progress, (ii) informing policy design, and (iii) policy appraisal. However, using subjective well-being to inform policy-makers is nothing new. For a long time, Bhutan has used subjective well-being information to both evaluate and plan public policies, and uses Gross National Happiness (GNH) as a national indicator of progress in addition to GDP. Recently, French president Nicholas Sarkozy set up a commission ("Stiglitz Commission"), led by Nobel Prize laureates Joseph Stiglitz and Amartaya Sen to "identify the limits of GDP as an indicator of economic performance and social progress; […] to consider what additional information might be required for the production of more relevant indicators of social progress; to assess the feasibility of alternative measurement tools, and to discuss how to present the statistical information in an appropriate way" (Stiglitz et al., 2009, p. 3).[3] Moreover, the United Kingdom under the leadership of Prime Minister David Cameron has established the "National Well-being Project," and the Office for National Statistics will publish the UK's first official subjective well-being index in 2012.

In this context, it is important to improve our understanding of the determinants of subjective well-being, in particular those that, like air quality, can be influenced, directly or indirectly, by public policy. The European Union (EU) has established an extensive body of environmental legislation over the decades to improve individual well-being by ensuring health-based standards for pollutants. For example, Directives 1996/62/EC, 1999/30/EC and 2002/3/EC[4] establish limit values for concentrations of sulfur dioxide (SO_2), oxides of nitrogen (NO and NO_2), particulate matter (PM_{10}), and carbon monoxide (CO) in ambient air.

In this paper (as in Luechinger, 2009; 2010), we limit our analysis to SO_2 for a number of reasons; firstly, it has an adverse impact on human health (e.g., Folinsbee, 1992), and, among the pollutants mentioned above, only PM_{10} and SO_2 can be directly noticed by humans. We note, however, that it is not necessary that respondents are aware of the pollution levels in order to find a statistically significant relationship between pollution and life satisfaction. The subjective well-being indicator should capture indirect effects of externalities on individuals' utility through effects on health and the like, even if there are no direct effects (Frey and Stutzer, 2005, p. 220). Secondly, the main source of SO_2 emissions is fossil fuel combustion at power plants and other industrial facilities, as opposed to non-stationary emitters (e.g., road transport in the case of CO, NO_2 and PM_{10}).[5] Thus, while SO_2 is a regional pollutant, the impacts of other pollutants are more localized (see, e.g., de Kluizenaar et al., 2001). Empirical analyses should use a finer level of disaggregation for the local pollutants. In Berlin, for example, PM_{10} concentrations at kerbside sites on main streets are up to 40% higher than in the urban background (Lenschow et al., 2001). We were not able to match individual respondents to accurate data on local pollution. The smallest spatial units at which ESS data are available are NUTS 3 regions.[6] In this context, using a regional rather than a local pollutant takes full advantage of the regional nature of our dataset.

The rest of the paper is organized as follows. In the next section we describe the data. Section 3 presents the empirical approach and Section 4 the results. Section 5 concludes.

[2] For more information about the European Social Survey see Section 2 and www.europeansocialsurvey.org.

[3] In the Commission, we also find Nobel Prize laureates Kenneth Arrow, James Heckman, and Daniel Kahneman, and prominent subject experts (Angus Deaton, Robert Putnam, Nicholas Stern, Andrew Oswald, and Alan Krueger).

[4] http://ec.europa.eu/environment/air/quality/legislation/existing_leg.htm.

[5] In the case of Ireland, for example, over 50% of total SO_2 emissions originate from one location in the West of Ireland (de Kluizenaar et al., 2001).

[6] The Nomenclature of Territorial Units (NUTS after the French Nomenclature d'Unites Territoriales Statistiques) is a geocode standard for referencing the subdivisions of countries for statistical purposes. There is a 3-level hierarchy for each EU member country with NUTS 3 referring to the smallest subdivision.