The Effects and Costs of Air Pollution on Health Status in Great Britain

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ABSTRACT

This study explores the effects of air pollution on self-reported health status and the health related costs in UK. The estimates are based on data from the British Household Panel Survey (BHPS). The effects of air pollution on individuals’ health status are estimated and their monetary value is calculated. In particular, two main air pollutants are examined; ground-level ozone (O₃) and carbon monoxide (CO). Moreover, various econometric approaches are followed. The annual monetary values of the health related costs for ground level O₃ range between £21-£25 for a drop of one unit, while the respective values for the CO range between £19-£21.

KEYWORDS

Air Pollution, Environmental Valuation, Fixed Effects, Health Costs, Health Status, Instrumental Variables, Marginal Rate of Substitution, Panel Data

1. INTRODUCTION

Air pollution leads to worst health outcomes and increased death probability (Currie and Neidell, 2005). However, policies to reduce pollution are often hardly fought on the ground of their high financial costs.

The purpose of this study is to examine the effects of air pollution and other determinants of self-reported health status. The analysis relies on detailed micro-level data, using local authority districts, instead of using cities or counties like other studies do (Ferreira et al., 2006; Luechinger, 2009). The advantage of using local authority districts is that it is possible to map the air pollution emissions at a detailed geographical reference implying more precise and more robust estimates. Additionally, two major air pollutants are explored, ozone (O₃) and carbon monoxide (CO).

The paper is organized as follows. Section 2 presents a short literature review. Section 3 describes the econometric framework. In section 4 the data and the research sample design are provided. In section 5 the results of estimating several versions of a health status function, with air pollution included, are reported, as well as, the effects of air pollution on health status and related costs are presented and discussed. In section 6 the concluding remarks are presented.
2. LITERATURE REVIEW

The Self-Assessed Health (SAH) has been used widely in previous studies of the relationship between health and socioeconomic status using British data (Benzeval et al., 2000; Salas, 2002; Adams et al., 2003; Contoyannis et al., 2004) and of the relationship between health and lifestyles (Kenkel, 1995; Contoyannis and Jones, 2004). The results are various. For example, regarding educational attainment a movement from unhealthy to a completely healthy lifestyle the proportions of individuals with higher levels of education gradually increases, while those that are unemployed are more likely to have an unhealthy lifestyle. Currie and Neidell (2005) used data from the Ambient Air Quality Database of California during the period 1989-2000 and data from the California Birth Cohort files in order to explore the effects of air pollution on infants’ weight. The authors found a significant effect of the prenatal exposure to air pollution on the probability that the infant will be born with low weight. However, when the regression analysis includes also the mother’s zip code they find a small average effect.

Knittel et al. (2011) examined the effects of PM$_{10}$ in California Central Valley and Southern California in the years 2002-2007. Knittel et al. (2011) used as an instrument to PM$_{10}$ weekly shocks to traffic and its interactions with ambient weather conditions. The authors argue that deviation from the regional norm originates from accidents and road closures. These shocks to traffic, and thus pollution, are likely to be uncorrelated with the error term in a model of infant mortality as a function of pollution exposure. Knittel et al. (2011) find that PM$_{10}$ has a large and statistically significant effect on infant mortality. Beatty and Shimshack (2011) examined the relationship between update on the ventilation filter (CCV) retrofits of school buses and respiratory health. Diseases, such as specifically bronchitis, asthma, and pneumonia were the main subject of exploration. Beatty and Shimshack (2011) used two databases for their research. The first source is hospital discharge admissions derived by the Washington State Department of Health. The second source is the retrofit database, which includes approximately 4,000 buses in 53 school districts of the Puget Sound area of Washington State. Beatty and Shimshack (2011) find that school bus retrofits induced statistically significant and large reductions in bronchitis, asthma and pneumonia incidence for children and adults with chronic conditions.

3. METHODOLOGY

3.1. Fixed Effects

The following model of health status using the life air pollution effects on health status for individual $i$, in area $j$ at time $t$ is estimated:

$$HS_{i,j,t} = \beta_0 + \beta_1 e_{i,j,t} + \beta_2 \log(y_{i,t}) + \beta_3 z_{i,j,t} + \gamma W_{j,t} + \mu_i + \theta_t + I_j T + \varepsilon_{i,j,t}$$  \hspace{1cm} (1)

$HS_{i,j,t}$ is the health status. The vector $e_{i,j,t}$ is the measured air pollution in location $j$ and in time $t$, $\log(y_{i,t})$ denotes the logarithm of personal or household income and $z$ is a vector of household and demographic factors, discussed in the next section. $W$ is a vector of meteorological variables, in location $j$ and in time $t$. Set $\mu_i$ denotes the individual-fixed effects, $I_j$ is a location (local authority) fixed effects, $\theta_t$ is a time-specific vector of indicators for the day and month the interview took place and the survey wave, while $I_j T$ is a set of area-specific time trends. Finally, $\varepsilon_{i,j,t}$ expresses the error term. Standard errors are clustered at the local authority level. To limit endogeneity issue the population of interest is limited to non-movers. Focusing on non-movers also allow us to capture unobservable
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