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Analysis

Estimating the cost of air pollution in South East Queensland: An application of the life satisfaction non-market valuation approach

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ABSTRACT

Making use of data from the Household, Income and Labour Dynamics in Australia (HILDA) survey coupled with air pollution data on PM_{10} exceedances generated by The Air Pollution Model (TAPM), this paper employs the life satisfaction approach to estimate the cost of PM_{10} exceedances from human activities in South East Queensland. This paper offers an estimate of the cost of PM_{10} exceedances from anthropogenic activities for the region of South East Queensland and provides further evidence on the association between air pollution (PM_{10} exceedances) and life satisfaction. A negative relationship is found between life satisfaction and the average number of days that ambient concentrations of PM_{10} exceed health guidelines. This yields an implicit willingness-to-pay, in terms of annual household income, for pollution reduction of approximately AUD 5000.
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1. Introduction

The negative effects of air pollution are substantial and wide-ranging. While health effects are of most concern, air pollution can also lead to loss of visibility for residents and recreationists, reduced agricultural and forest productivity, damage to buildings and structural materials, and stress on ecosystems. Together these effects impose significant economic costs on governments, businesses and households. Accurately estimating these costs is an important component of the development of efficient pollution reduction policies (United States Environmental Protection Agency, 2011).

Extending 240 km from Noosa in the north to the Gold Coast/New South Wales border in the south and 140 km west to Toowoomba, South East Queensland (SEQ) is one of Australia's fastest growing and most densely populated regions. In 2007 Brisbane City, the principle urban centre of the SEQ region, was the second fastest growing urban centre in the developed world (Newman, 2007) and the resident population of the region is projected to increase by 44%, to 4.6 million, by 2031 (Office of Economic and Statistical Research, 2011).

This growth has been accompanied by persistent exceedances of air quality standards for particulate matter with an aerodynamic diameter of less than 10 μm (PM_{10}).[1] Addressing these exceedances in order to remedy direct (health) and indirect (broader well-being) effects is a priority for public policy (cf. Brisbane City Council, 2009). Current initiatives, however, have proven to be relatively ineffective, with no discernible downward trend in PM_{10} exceedances over the past decade (Queensland Department of Environment and Heritage Protection, 2011).

While a number of existing studies clearly demonstrate a link between the region's air quality and residents' health and well-being (cf. Chen et al., 2007; McCrea et al., 2005; Petroeschevsky et al., 2001; Rutherford et al., 2000; Simpson et al., 1997), to the best of our knowledge, there are no publicly available monetary estimates of the cost of air pollution in the region. The purpose of this paper is to fill this knowledge gap and estimate the cost of PM_{10} exceedances from anthropogenic activities in SEQ. The chosen valuation method is the life satisfaction approach.

The paper proceeds as follows. Section 2 outlines the method and data. This section includes an extensive discussion on the measure of life satisfaction, socio-economic, demographic and spatial control variables, and air pollution measure. Model results and valuation estimates are presented in Section 3. Section 4 discusses and concludes.

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[1] Exceedances are defined as an average maximum ambient concentration over a 24-hour period of more than fifty micrograms of PM_{10} per cubic metre. Australian Government Department of the Environment, 2013. Air quality standards. Available http://www.environment.gov.au/topics/environment-protection/air-quality/air-quality-standards, accessed: 15 November 2013.

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Table 1
Model variables.

Variable name	Definition	Mean (std. dev.)	% Value 1 (DV)
Life satisfaction	Respondent's self-reported life satisfaction (scale 0 to 10)	7.9097 (1.6025)	
Age (15–19)	Respondent is between 15 and 19 years of age		5.8%
Age (20–29)	Respondent is between 20 and 29 years of age		14.6%
Age (40–49)	Respondent is between 40 and 49 years of age		22.9%
Age (50–59)	Respondent is between 50 and 59 years of age		15.9%
Age (60 or greater)	Respondent is 60 years of age or greater		17.3%
Male	Respondent is male		46.8%
ATSI	Respondent is of Aboriginal and/or Torres Strait Islander origin		1.5%
Immigrant English	Respondent is born in a main English speaking country (main English speaking countries are: United Kingdom; New Zealand; Canada; United States of America; Ireland; and South Africa)		13.3%
Immigrant non-English	Respondent is not born in Australia or a Main English Speaking country		6.8%
Married	Respondent is legally married		57.2%
De facto	Respondent is in a de facto relationship		11.2%
Separated	Respondent is separated		2.7%
Divorced	Respondent is divorced		9.5%
Widow	Respondent is a widow		2.8%
Lone parent	Respondent is a lone parent		0.9%
Number of children	Number of respondent's own resident children in respondent's household at least 50% of the time and number of own children who usually live in a non-private dwelling but spend the rest of the time mainly with the respondent	0.8422 (1.2019)	
Long-term health condition	Respondent has a long-term health condition, that is a condition that has lasted or is likely to last for more than six months		22.1%
Year 12	Respondent's highest level of education is Year 12		2.0%
Certificate or diploma	Respondent's highest level of education is a certificate or diploma		28.9%
Bachelors degree or higher	Respondent's highest level of education is a Bachelors degree or higher		19.4%
Employed part-time	Respondent is employed and works less than 35 h per week		19.4%
Self-employed	Respondent is self-employed		8.1%
Unemployed	Respondent is not employed but is looking for work		5.0%
Non-participant	Respondent falls into the other non-participant category		31.2%
Household income	Disposable household income	$48,571.1 ($27,242.8)	
Importance of religion	Respondent's self-report of the importance of religion to them (scale 0 to 10)	4.5617 (3.4709)	
Others present	Someone else was present during the interview		36.6%
Extraversion	Degree of extraversion (scale 1 to 7)	4.4193 (1.0472)	
Agreeableness	Degree of agreeableness (scale 1 to 7)	5.4023 (0.9250)	
Conscientiousness	Degree of conscientiousness (scale 1 to 7)	5.2035 (1.0255)	
Emotional stability	Degree of emotional stability (scale 1 to 7)	5.1598 (1.0920)	
Openness to experience	Degree of openness to experience (scale 1 to 7)	4.2404 (1.0621)	
Major city	Respondent is considered to reside in a major city region as defined by the Australian Bureau of Statistics' Accessibility/Remoteness Index of Australia		74.7%
Population density	Number of individuals per square kilometre in the respondent's CD	1,751.1 (1,367.9)	
SEIFA index	The Australian Bureau of Statistics' (ABS) Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socio-economic Disadvantage for the CD in which the respondent resides	5.4081 (2.8103)	
Local interaction	Respondent observes neighbourly interaction and support	6.6213 (2.0093)	
Local disamenity	Respondent observes local disamenity	10.5201 (2.8452)	
Local insecurity	Respondent observes insecurity in the neighbourhood	10.0784 (3.5465)	
Proximity to coast	Respondent resides within 3 km of the coastline		20.0%
Proximity to airport	Respondent resides within 5 km of an international airport		1.3%
Public greenspace	Percentage of public greenspace in the respondent's CD		7.7%
PM_{10} exceedances (days)	Average annual number of days that the PM_{10} concentration level has exceeded 24 hour health guidelines for the CD in which the respondent resides	0.4291 (3.0931)	
Humidity (%)	Average annual humidity for the CD in which the respondent resides	73.6156 (2.0270)	
Rainfall (mm)	Average annual rainfall for the CD in which the respondent resides	116.7853 (109.1752)	
Temperature (°C)	Average annual temperature for the CD in which the respondent resides	20.1097 (0.8980)	
Temperature range (max–min) (°C)	Average annual temperature range for the CD in which the respondent resides	8.923 (0.7164)	
Wind speed (m/s)	Average annual wind speed for the CD in which the respondent resides	2.4975 (0.5315)	

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