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Analysis

The valuation of landfill disamenities in Birmingham

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ABSTRACT

The disposal of waste by landfill generates community concerns, during both site operations and following the cessation of activities. Whilst previous hedonic studies have generally examined the impact on property prices of distance to the nearest active landfill site this paper presents a study for Birmingham in England in which properties are simultaneously located close to numerous active and historical landfill sites. Accounting for the proximity of historical landfill sites alters the perceived disamenity impact of active sites and furthermore, reveals evidence of significant disamenity impacts, decades after site closure, albeit over shorter geographical distances. Estimated disamenity impacts are however somewhat sensitive to assumptions regarding the geographical range of the externalities generated by landfill.

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1. Introduction

Recent years have witnessed significant changes in waste management policies in order to reduce the amount of waste generated and to encourage recycling, as well as addressing the perceived problem of over-reliance on landfill as a means of disposal. The amount of waste however appears ever-increasing and landfill remains the most prevalent method of disposal in many parts of the European Union, particularly the United Kingdom. There is moreover continuing concern that, despite the existence of measures like the landfill tax, the cost of disposing of waste through landfill is still priced at levels which fail fully to internalise the social costs.

The negative effects of landfill include emissions of methane, which is a potent greenhouse gas. Landfill leachate, generated when rainwater mixes with waste in landfill sites, may contaminate groundwater. The day to day operation of landfill sites can also affect nearby households through nuisances like noise, visual intrusion, odour, wind-blown litter, flies and vermin. Traffic to and from landfill generates noise, traffic congestion and localised air pollution. Proximity to a landfill site can also generate 'stigma' damages not attributable to any physical impact. Each of these impacts operates over a different geographical scale and may persist even after landfill sites are closed.[1]

Ignoring the fact that some impacts are global in nature, in an attempt to quantify the localised disamenity-impacts of landfill previous authors have often used the hedonic price technique. Starting with Havlicek et al. (1971) such attempts appear motivated by a desire better to inform policy makers of the true environmental cost of landfill disposal, thereby providing part of the information necessary to develop an optimal waste management program. But only a handful of studies exist outside the United States (e.g. Cambridge Econometrics, 2003).[2] Furthermore, not infrequently studies include only a limited number of structural and accessibility-type variables (for an exception see Ready, 2005). And critically, two issues remain inadequately researched namely the impact of site closure and proximity to multiple landfill sites.

Only five studies investigate closed sites (Bouvier et al, 2000; Guntermann, 1995; Halstead et al., 1997; Kinnaman, 2009; Skaburskis, 1989) and of these, two suggest no impacts on property prices, two studies point to negative impacts, and one provides mixed results. Furthermore, although it is of obvious interest to determine the time-profile of post closure impacts only Kinnaman (2009) contains a before-and-after study of property prices, including data from the period 1957 to 2005 for a single site that closed in 1976. No study address the question of whether the geographical limit of disamenity impacts changes once a site is closed.

Studies utilising microeconomic data have studied either single sites or combined data from different areas each containing a single active or inactive landfill site. Only one has dealt with a situation in which a large number of properties are simultaneously located close to more than one landfill site (Cambridge Econometrics, 2003). By contrast, four studies using aggregate data account for the existence of multiple sites e.g. the number of landfill sites within a municipality (Blomquist et al, 1988; Brasington and Hite, 2005; Clark and Nieves, 1994; Ketkar, 1992). But these studies do not include any historic sites and their reliance on aggregate data implies a significant loss of control in the hedonic price regression.

The contribution of this paper therefore, is twofold. First, using microeconomic data this study investigates the impact of landfill on

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[1] Other costs of an overreliance on landfill disposal include the loss from not recycling valuable materials.

[2] This study pertains to Great Britain. For examples of studies undertaken in Africa see Arimah and Adinnu (1995); Du Preez and Lottering (2009).

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property values in the context of what we regard as the 'standard case' in which properties are often simultaneously located close to more than one landfill site. This is achieved by combining GIS data on landfill sites taken from the Environment Agency with data on housing transactions in Birmingham in England compiled by Bateman et al. (2004). Second, by distinguishing between historical landfill sites according to when they closed we investigate the time profile of disamenity impacts following the cessation of landfill activities. We also investigate whether the geographical extent of disamenity impacts changes following site closure.

To anticipate our main findings it appears that, at least in the case of Birmingham, accounting for proximity to multiple historical landfill sites alters the estimated disamenity impact of active landfill sites. This occurs because active and historical landfill sites are often located next to one another. Furthermore, historical landfill sites appear to depress property prices for many decades after their closure, albeit over shorter geographical distances.

The remainder of the study is organised as follows. In the next section, we provide a suitably brief overview of the hedonic pricing technique. The third section reviews the empirical evidence on the impact of proximity to a landfill site on property values. The fourth section describes the dataset used in the current exercise. Section five describes our methods whilst section six presents the results. The final section concludes.

2. The Hedonic Price Technique

Housing consists of a bundle of structural, neighbourhood, accessibility and environmental attributes.[3] Any property can therefore be fully described by the vector Z:

$$Z = \left(z_1, z_2, \ldots, z_J\right)$$

where z describes the level of each of J different housing attributes. Given the stock of housing, property prices are determined by the interaction of supply and demand and the price P of any given house will be determined by the vector Z describing its attribute levels:

$$P = P(Z)$$

Given the hedonic price function, hedonic theory then considers how individual households choose the optimal bundle of housing attributes. Assume that household utility U is determined by the consumption of a composite commodity X with price equal to 1 and the vector of housing attributes Z:

$$U = U(X, Z)$$

The budget constraint is:

$$M - P(Z) - X = 0$$

where M is income. The first order necessary condition with respect to housing characteristic z_j is:

$$\frac{\left(\partial U / \partial z_j\right)}{\lambda} = \frac{\partial P(Z)}{\partial z_j}$$

where λ is the marginal utility of income. This equation states that marginal willingness to pay for z_j must equal the implicit price of an additional unit of z_j. Identification of the demand curve for z_j however requires additional information on how households possessing known socioeconomic characteristics would react to a different set of implicit prices (Brown and Rosen, 1982).

The hedonic technique assumes buyers have full information concerning the price of housing and attribute levels, as well as the absence of transactions costs, which may prevent households from relocating to a more preferred site. In addition, unless a continuum of housing-attribute levels is available households may have to choose a house which does not satisfy the first-order conditions of utility maximization (Maler, 1977).

Estimating the hedonic price function involves controlling for all those attributes affecting the price of property. Since theory does not provide an exhaustive list of relevant housing attributes there is however, an omnipresent risk of inadvertently excluding important ones thereby inviting bias and inconsistency or, more benignly, including redundant ones risking only inefficiency. The cross sectional data used in hedonic analyses may also exhibit spatial autocorrelation if important omitted attributes are spatially correlated.

Empirical analysis also requires selecting an appropriate functional form for the hedonic price function. Since the repackaging of housing attributes is typically impossible the hedonic price function may be nonlinear suggesting use of the semi-log or log–log specifications. Use of the Box Cox transformation is also commonplace (see e.g. Halvorsen and Pollakowski, 1981). It is important to test whether the observations are drawn from a segmented property market and hence whether it is appropriate to fit two or more piecewise regressions to the data (Straszheim, 1984).

3. Literature Review

Accessing ECONLIT on 1st June 2010 a total of 59 journal articles, working papers and dissertations were identified containing the words 'hedonic' and 'waste' anywhere within the abstract.

The earliest hedonic analysis of the disamenity impacts of landfill appears to be Havlicek et al. (1971) which, like almost all subsequent studies, uses distance to the nearest landfill as a proxy for the disamenity impact (see also Havlicek et al., 1985). An adverse impact of landfill is also detected in Hockman et al. (1976) and Gamble et al. (1982). Employing a slightly different methodology, Research and Planning Consultants Incorporated (1983) compare the price of property near to a landfill site with that of comparable property elsewhere (see also Petit and Johnson, 1987). Nelson et al. (1992) estimate the effect of an active landfill site on nearby house prices and Ready and Abdallah (2003) present a method for testing the geographical limits of landfill impacts. Some studies examine the impact of landfill sites on the change in property values over time (see Goldberg et al., 1972; Groth, 1981; Greenberg and Hughes, 1992). For a critique of such studies see Bleich et al. (1991). Note also that a number of researchers find no evidence of disamenity impacts from active landfill sites whereas others find perverse results (e.g. Gamble and Downing, 1984; Schmalensee et al., 1975).

Some papers focus on changes in the risk presented by particular landfill sites. Adler et al. (1982) and Cook et al. (1984) analyse property prices both before and after the discovery of site contamination. Kohlhase (1991) emphasises the importance of public awareness. Smolen et al. (1992) examines the impact of a proposal for a low-level radioactive waste site. Other interesting 'before-and-after' studies include Wise and Pfeifenberger (1994) and Reichert (1997). Some studies like Schulze et al. (1986) include risk perception variables. Hite (1998) uses survey data pertaining to four landfill sites with differing life-expectancies.

Other studies focus on the long-term effects of landfill on property values testing for any reduction in property values even after closure. Guntermann (1995) uses interactive dummy variables to identify active landfills. Halstead et al. (1997) examines 'stigma-related' damages from an inactive landfill site. Skaburskis (1989) focuses on identifying the geographical extent of landfill impacts. Bouvier et al. (2000) measures the disamenity impacts of six sites of which two were open and the

[3] The hedonic price technique and its application to the housing market are extensively discussed elsewhere (e.g. Freeman, 2003; Pamlquist, 1999).

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