



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

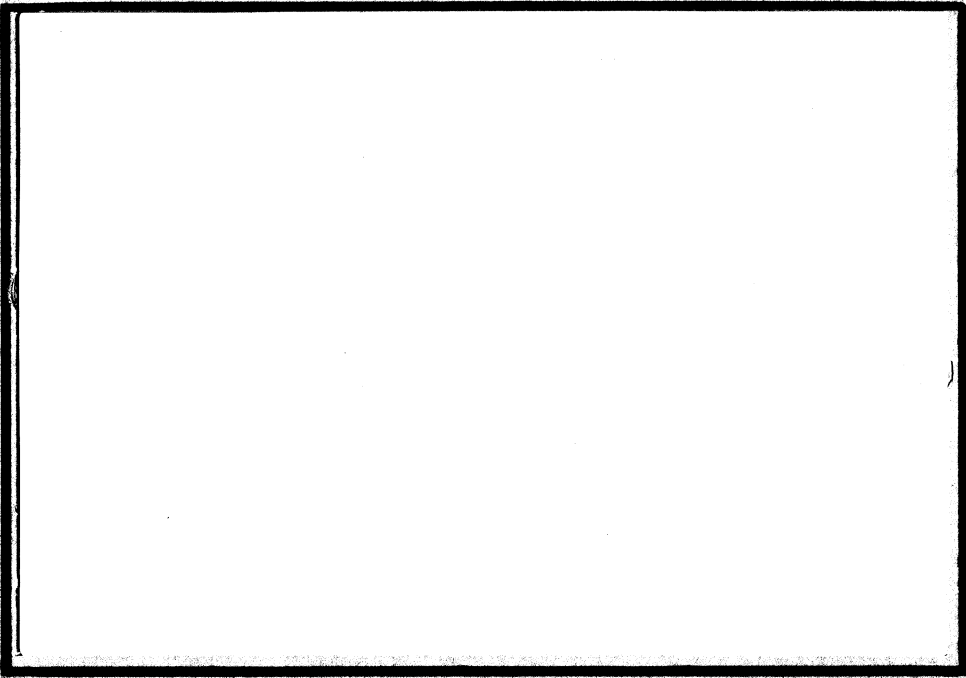
Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Waste
C

UNIVERSITY OF CALIFORNIA
DAVIS
JUN 8 - 1972
Agricultural Economics Library



PAPER PRESENTED AT THE ANNUAL MEETING OF THE
AMERICAN AGRICULTURAL ECONOMICS ASSOCIATION,
CARBONDALE, IL. AUGUST 15-18, 1971



DEPARTMENT OF AGRICULTURAL ECONOMICS

**Purdue University
Lafayette, Indiana**

MEASURING THE IMPACTS OF SOLID WASTE
DISPOSAL SITE LOCATION ON PROPERTY VALUES

Joseph Havlicek, Jr., Robert Richardson
and Lloyd Davies

MEASURING THE IMPACTS OF SOLID WASTE
DISPOSAL SITE LOCATION ON PROPERTY VALUES*

Joseph Havlicek, Jr., Robert Richardson
and Lloyd Davies**

Introduction

One of the more pressing problems facing communities, cities and metropolitan areas is that of handling and disposing of solid wastes. An average of over a ton per person of various types of solid wastes is collected annually in the United States. In addition to garbage and other household wastes, solid wastes include the solid residuals from commercial, industrial, demolition, and municipal sources. There are no apparent forces which suggest that the quantities of solid wastes which will have to be handled and disposed of in the future will diminish or even remain constant.

The acquisition by a public body or private individual of sites for solid waste disposal facilities is no easy task. Generally, there is strong adverse reaction of communities to having any type of solid waste facility located nearby. One of the major objections raised against

*Contributed paper presented at the annual meeting of the American Agricultural Economics Association, Carbondale, Illinois, August 15-18, 1971.

**Havlicek is a professor and Richardson and Davies are research assistants in the Department of Agricultural Economics at Purdue University.

having a disposal site located nearby is that the values of surrounding properties will be adversely affected. The objections to the location of a solid waste disposal site nearby may not be without basis since generally no provision is made to compensate those in a community who may suffer loss or bear risk of loss because of externalities^{1/} which may emanate from the solid waste facility.

Solid waste problems are frequently relevant to rural and smaller town communities.

"Solid waste problems are by no means confined to cities and large metropolitan areas. Failure to recognize solid waste problems in rural areas may be one reason why open dumps, open-dump burning, and littering occur and are making many rural areas lose their advantage over cities in environmental quality. As urban frontiers penetrate deeper into rural areas, solid waste problems in rural areas will become more critical. To add to the problems, sparsely populated rural areas are becoming prime candidates for location of disposal sites for wastes generated in large metropolitan areas. The need for attention to solid wastes is accentuated by the fact that governments in rural areas are not as well equipped in manpower, expertise, and other resources to deal with solid waste problems as are governmental units for cities and larger metropolitan areas." [2, p. 1598].

Little is known about whether solid waste disposal sites give rise to external effects and if so the magnitude and distribution of such external effects.

The objective of this paper is to present a prediction type of model for evaluating the composite of external effects on property prices in the proximities of solid waste disposal sites. Emphasis is on providing

^{1/} Externalities arise whenever the value of individuals' consumption functions or utility functions or firms' production functions depend directly upon the activities of others and are altered by effects which are not deliberately created but are unintended or incidental by-products of some otherwise legitimate activities. For a comprehensive treatment of externalities see [4].

policy information with respect to both the location of disposal sites and the basis for compensation of bearers of external effects.

The Model

Exposure to the external effects of solid waste disposal sites is just one set of variables which determine the values of residential properties. Other sets of variables relevant to the determination of prices evolve from the supply and demand structures for residential properties. There is a separate but related structure of demand and supply for newly constructed housing, and for the stock of existing housing. This paper is concerned only with the market for, and value of, existing housing. The supply and demand structure for this stock of housing is relevant only in that it indicates the relevant variables. Focus is on a reduced form relationship for estimating the prices of residential properties (for a similar treatment of aircraft nuisance effects see [1]). Particular emphasis is placed on price of residential property with respect to solid waste disposal site location.

The price of residential property is hypothesized to be functionally related to three general categories of variables - physical attributes of the residential property, general level of cost of housing, and factors representing amenities and disamenities associated with solid waste disposal site and neighborhood characteristics.^{2/} The housing unit and accompanying land are considered together with no attempt to separate

^{2/}A similar categorization of variables was used by Ridker [6] in evaluating the effects of air pollution, and by Penn [5] in a model for measuring residential property values.

the value of the housing service from site value. The basic residential property price relationship considered in this study is as follows:

$$Y = f (X_1, X_2, X_3, X_4, \dots, X_{13}, X_{14})$$

where

Y is the transaction price in current dollars.

X_1 is the size of the house in square feet.

X_2 is the number of bedrooms.

X_3 is the number of bathrooms.

X_4 is the age of the house to the nearest whole year.

X_5 is the size of lot in square feet.

X_6 is the amount of encumbrance in dollars.

X_7 is a zero-one variable representing owner (0) or tenant (1) occupancy.

X_8 is the year of sale measured in terms of the last two digits of the year.

X_9 is the absolute degrees that the residential property is away from downwind (prevailing) of the solid waste disposal site.

X_{10} is the distance in feet that the residential property is from the nearest solid waste disposal site.

$X_{11}, X_{12}, X_{13}, X_{14}$ are zero-one variables representing four solid waste disposal sites.

The first seven exogenous variables represent the physical characteristics of the housing unit and the lot. They represent some of the key features of the quantity and quality of the living service of a piece of residential property. X_1 , the size of the house, is hypothesized to be positively

related to the price of the property. X_2 , the number of bedrooms, and X_3 , the number of bathrooms, are assumed to be indicators of the quality of the house and are hypothesized to be positively related to the price of the residential property. X_4 , the age of the house, is an indicator of the remaining service of the structure and the older the house the less service remains; thus the variable is hypothesized to be negatively related to the price of the residential property. X_5 , lot size, is hypothesized to be positively related to the price of residential property on the basis that larger lots are considered a desirable attribute of a residential property contributing both to the living service and site value. X_6 , the amount of encumbrance, is viewed as a proxy for the amount of mortgage which a buyer may be able to assume and is hypothesized to positively relate to the price of the residential property. Finally, X_7 , a measure of owner-tenant occupancy, is hypothesized to be inversely related with the price of the residential property on the basis that individual dwelling rental properties tend to be of a lower price level and owner occupied houses are assumed to be better maintained and in better condition in general than tenant occupied houses.

The year of sale, X_8 , is a proxy for a measure of changes in the general price level and cost of housing. Such changes affect the cost of construction of new houses and the transaction prices of the existing stock of houses. In analyzing a time series of residential property prices it would be desirable to adjust for changes in the general price level; however, such a "deflator" was not available for the geographical area in which the residential properties were being investigated. On the assumption that for the time period being investigated the general

price level was monotonically increasing, the year of sale was incorporated as a surrogate and is hypothesized to be positively related to the price of residential property.

The absolute angle variable, X_9 , and the distance that the residential property is from the nearest solid waste disposal site, X_{10} , are variables of special interest in the model. They represent measures of the external effects of solid waste disposal sites if such external effects exist. The impacts which solid waste disposal sites might have on nearby properties are not as clearcut as it may first appear. The effects of a solid waste disposal site operated according to high standards could be neutral. Neutral effects may arise because there really are no effects on property prices or there may be adverse effects which are being offset by discounted future benefits which may occur say after a landfill is completed. In rare cases the solid waste disposal site could have appreciative effects on surrounding properties. This could occur if previous activities at the location were more adverse or hazardous than the solid waste disposal site. Also, some solid waste disposal sites such as sanitary landfills might immediately provide land reclamation services or add to the stability of an area with ravines and gullies and positively effect property prices. However, more frequently solid waste disposal sites are potential sources of externalities which adversely effect the prices of nearby properties.^{3/}

Underlying the particular formulation of the absolute angle and distance variables is the notion of a diffusion type of phenomena. The

^{3/} For further discussion of this issue see Havlicek [3, pp. 5-6].

properties closest to the solid waste disposal site will receive the greatest exposure and will be most adversely affected. The externalities are assumed to dissipate with distance from the disposal site. Furthermore, since some of the potential sources of adverse external effects such as noise, odor, dust and strewn paper are wind carried, the prevailing winds are an integral element of the diffusion process. Residential properties directly downwind will be most adversely affected and the severity of the adverse affects is assumed to diminish for properties located further away from downwind of the solid waste disposal site. Both the angle and distance variables are hypothesized to be positively related to the price of residential properties.

The amounts of severity of external effects which may be emitted by solid waste disposal sites depend on the quality of site operation and various characteristics of the site. The composite of the attributes of the solid waste disposal sites are incorporated in the model as zero-one discrete variables. In the study area there are five solid waste disposal sites which are incorporated in the model as X_{11} , X_{12} , X_{13} and X_{14} . Since one of the solid waste disposal sites was arbitrarily omitted for statistical purposes and the included sites measure shifts in the residential property price surface relative to the omitted site, no hypotheses are made about the relationship of the discrete solid waste disposal site variables and the price of residential property. Some caution needs to be exercised in interpreting these discrete variables since they may not only be representing solid waste disposal site attributes, but also neighborhood characteristics of the area in which the solid waste disposal sites are located. For example, if poorly operated

sites are located in low quality neighborhoods and well operated sites are located in better quality neighborhoods, the discrete variables may be representing both, with no way of separating the two effects.

Sample Data

Data used in this study were obtained from the records of the Multiple Listing Service (MLS) in Fort Wayne, Indiana. This is a service provided jointly by real estate agents in the city to widen the market for housing. It provides a standardized format for listing houses for sale and provides information on location and dwelling characteristics in detail. The date of sale and sale price are also recorded.

The sample data for this study is a mixture of time series and cross sectional data. The data include a total of 182 single unit house sales during the period 1962 to 1970 in the neighborhood around each of five solid waste disposal sites in the Fort Wayne area. The MLS data provide information on the dwelling characteristics (variables X_1 to X_8) and the selling price (Y). Dwelling locations were then visited to record the diffusion and neighborhood site variables used in the study. The prevailing winds in the area are from the southwest and were used to compute the angle variable for each dwelling transaction entering the data series.

Empirical Results

The price estimating equation specified earlier and two alternative models which contain additional neighborhood characteristic variables were estimated by least squares techniques. All three models are linear

in actual variates. The estimated coefficients, their respective standard errors, and coefficients of determination for the three alternative models are presented in Table 1. The basic model is denoted as Model I; Model II contains an additional variable representing distance to the nearest industry and Model III adds to Model II a variable measuring the distance to the nearest shopping center. The proportion of explained variation of residential property prices (R^2) for the three models are respectively, .78, .79, and .79.

Emphasis in the discussion of the statistical results is on the basic price estimating equation, Model I. Coefficients for each of the three major groups of variables as outlined earlier are discussed separately.

(1) Physical Attributes of the Property

The coefficients of the variables X_1 through X_7 are significantly different from zero at least at the .05 level of significance, and some are significant at the .01 level. Except for the coefficient of X_2 , the number of bedrooms, all estimated coefficients of the physical attribute variables have the hypothesized signs. The number of bedrooms was hypothesized to be positively related to the price of residential property whereas the sign of the estimated coefficient is negative.

For the ranges of data used in estimating the relationship, the coefficients indicate the following relationships between physical attributes of the property and its selling price. An extra square foot of house space (X_1) is valued at \$8.10, and an additional square foot of lot space (X_5) is valued at 1.2 cents. The value of the residential property declines an average of \$120.50 per year for each additional year of

Table 1. Coefficients and Associated Standard Errors for Three Alternative Residential Property Price Models.

	Model I		Model II		Model III	
	Estimated Coefficient	Standard Error	Estimated Coefficient	Standard Error	Estimated Coefficient	Standard Error
Intercept	-21247.9	8245.3	- 8692.0	8900.8	-11184.9	8960.8
X ₁	8.1	0.9	7.1	1.0	6.7	1.0
X ₂	- 1252.2	466.4	- 998.8	460.3	- 854.8*	464.9
X ₃	3781.4	797.7	3510.8	780.3	3508.2	775.6
X ₄	- 120.5	24.7	- 109.4	24.3	- 106.6	24.2
X ₅	0.012	0.006	0.013	0.005	0.013	0.0056
X ₆	0.105	0.051	0.012	0.05	0.13	0.05
X ₇	- 2208.8	886.5	- 2329.7	863.1	- 2276.1	858.4
X ₈	349.8	123.4	346.9	120.0	366.4	119.8
X ₉	10.3*	8.1	11.8*	7.9	12.1*	7.9
X ₁₀	0.61	0.28	0.82	0.28	0.69	0.29
X ₁₁	- 1382.7*	1130.2	-12544.7	3603.9	-10851.8	3710.6
X ₁₂	- 245.2**	1175.1	-11610.5	3676.8	- 7979.6*	4203.6
X ₁₃	- 4624.7	1577.4	-15426.2	3658.6	-13978.8	3729.4
X ₁₄	762.3**	946.8	- 8170.0	2896.9	- 5047.1*	3284.6
X ₁₅			- 0.48	0.15	- 0.37	0.16
X ₁₆					- 0.18*	0.10
R ²	.77		.79		.79	

Coefficients marked with asterisks are not significant at the 5 percent level (*) and not significant at the 10 percent level (**) for the appropriate t test.

age of the house (X_4). The amount of encumbrance (X_6) is positively related to the price of the residential property and valued at 10.5 cents per dollar of encumbrance. Occupancy by a tenant rather than an owner reduces the price on the average by \$2208.80. The estimated coefficient for X_3 , the number of bathrooms, suggests that an additional bathroom is valued at \$3781.40. This estimate should be viewed with caution because the variable may also be accounting for the effects of other quality factors associated with houses having more than a single bathroom.

The estimated coefficient of X_2 , number of bedrooms, is opposite in sign from that hypothesized and indicates that the price of residential property changes inversely by \$2152.20 for each one room change in the number of bedrooms in the house. This unexpected result may have occurred because of an excess supply of houses with a certain number of bedrooms during the sample time period. Also, our data generally pertain to lower priced housing (the mean price is \$16,297), and a greater number of bedrooms may result in smaller sized rooms which reduces the quality of living service and is discounted by prospective buyers. The behavior of this variable for alternative property characteristics and market conditions merits further investigation.

(2) Cost of Housing Variable

The year of sale, X_8 , is used as a serrogate to account for changes in the general price level and the general level of cost of housing. The sign of the estimated coefficient is as hypothesized, and the coefficient is significantly greater than zero at the .01 level of significance. The estimated coefficient indicates that the annual rise in the cost of housing for the sample area and time period including inflation is \$349.80.

(3) Diffusion and Site Variables

This group of variables includes X_9 through X_{14} in Model I. In the two alternative models the additional diffusion variables, X_{15} , distance in feet to the nearest industrial location, and X_{16} , distance in feet to the nearest shopping center, were analyzed. These two variables were included in an attempt to measure amenities and/or disamenities of residential property location relative to industry and shopping along with the solid waste disposal site diffusion and site characteristic variables.

Variables X_9 and X_{10} are the key policy variables in the model. Both of these estimated coefficients are positive, as hypothesized, suggesting that a premium in price is placed on being away from downwind of solid waste disposal sites (X_9) and being a greater distance away from solid waste disposal sites (X_{10}). The coefficient of the angle variable is significantly greater than zero at the .10 level of significance, and the coefficient of the distance variable is significantly greater than zero at the .05 level of significance. The estimated coefficient of the angle variable indicates that for each degree away from downwind of a solid waste disposal site, the value of a piece of residential property increases \$10.30. The estimated coefficient for the distance variables suggests that the price of residential property increases \$0.61 per foot of distance away from a solid waste disposal site. The estimated coefficients of these two variables suggest that solid waste disposal sites are sources of adverse external effects which are borne by owners of surrounding properties. The estimated coefficients provide a basis for

better estimating the costs of solid waste disposal and for compensating the recipients of the negative external effects of solid waste disposal site location.

The estimated coefficients of the zero-one variables indicate differences between the sites. These differences represent effects which characteristics and quality of operation of the five solid waste disposal sites have on the price of residential properties. The effects are measured in terms of differences in the position of the price surface for each of the four included sites relative to the arbitrarily omitted site. In Model I two of the four estimated coefficients were not significantly different from zero at the .10 level of significance, one was significantly different from zero at the .10 level and one was significantly different from zero at the .05 level.

In both Model II and Model III the estimated coefficients of the variable measuring distance to the nearest industry (X_{15}) are negative and significantly different from zero at the .05 level of significance. In Model III the estimated coefficient of the variable measuring distance to the nearest shopping center (X_{16}) is negative and significantly different from zero at the .10 level of significance. The estimated coefficients of these two variables basically indicate that this residential property market is evaluating proximity to the industry and shopping as an amenity. Also, when these two distance variables are included in the equation some substantial changes occur in the estimated coefficients of other variables in the model. This raises some questions about what these two distance variables are measuring and suggests that additional research on the disaggregation of amenities and disamenities included in these variables is needed.

Conclusions

The analysis presented is a first attempt at estimating the impacts which solid waste disposal sites have on values of surrounding properties. The estimated model provides a starting point for assessing the impacts of external effects of solid waste disposal site location. The results suggest some important implications for community development, social welfare, and local government policy making. In the case of decisions concerned with solid waste disposal site location, the external social costs and benefits are an integral and perhaps major factor in the decision. The empirical estimates suggest the magnitude of costs imposed and indicate the nature of their distribution (or diffusion) around the solid waste disposal site location.

Further research is needed in several related areas. There is a need to refine the measurements of variables particularly measures of the quality of operation of the disposal sites and neighborhood characteristics. Separation of these two sets of effects may be critical. Also, the non-linear aspects of the diffusion variables merit consideration. Other sources of both amenities and disamenities need to be considered; for example, proximity to schools, churches, industry, shopping, etc. It would also be desirable to expand the sample to include a wider range of proximity to sources of amenities and disamenities. In this study, only impacts on transaction price were analyzed and energetic research focusing on the rental market may be rewarding. Empirical information about these factors will facilitate decision making in the area of solid waste management and pose a challenge for economists in the area of environmental quality.

Selected References

- [1] Emerson, F. C., The Determinants of Residential Value with Special Reference to the Effects of Aircraft Nuisance and Other Environmental Features, " Unpublished Ph.D. Dissertation, University of Minnesota, August. 1969.
- [2] Havlicek, Joseph, Jr., George S. Tolley, Yi Wang, "'Solid Wastes' - A Resource?", American Journal of Agricultural Economics, Vol. 51, No. 5, December 1969.
- [3] Havlicek, Joseph, Jr., "Environmental Problems and Approaches to Their Solution at the Consumer Level," Proceedings of the 1971 National Agricultural Marketing Conference, Denver, Colorado, April 27-29, 1971 (forthcoming).
- [4] Mishan, E. J., "The Postwar Literature on Externalities: An Interpretative Essay," Journal of Economic Literature, Vol. IX, No. 1, March 1971.
- [5] Penn, J.B., "Using Multiple Listing Service Data to Analyze Determinants of Urban Residential Property Values," Urban Economics Report No. 39, University of Chicago, September 1970.
- [6] Ridker, Ronald G., Economic Costs of Air Pollution - Studies in Measurement, Frederick A. Praeger Publishers, New York 1967