AIRCRAFT NOISE AND RESIDENTIAL PROPERTY VALUES ADJACENT TO MANCHESTER INTERNATIONAL AIRPORT

By G. Pennington, N. Topham and R. Ward*

1. INTRODUCTION

An enormous growth in the volume of air traffic over recent years has brought with it increasing concern about the level of aircraft noise. In February 1989 the EC Commission published a draft Directive stating that the Commission proposes to ban, from November 1990, the addition to European airline fleets of any aircraft which received its acoustical certificate before 1977. This proposal presumes that aircraft noise is a serious problem. If this is so, it should reflect itself in property values. Interesting results on the effects of aircraft noise might be expected from an examination of the variation in house prices around a busy international airport such as that of Manchester.

This paper uses house mortgage data and noise contour maps for Manchester International Airport to reveal a low negative, but weak and non-robust, relationship between aircraft noise and property values. The paper is divided into three further sections. Section 2 puts the present study in the context of previous work, and presents results for Manchester International Airport which are then compared with the results from previous studies of other airports. Initial estimates are within the range of previous findings, but Section 3 shows that this effect reduces to zero when neighbourhood effects are allowed for. Section 4 then draws the following conclusions: since the level of explanation is high and the data set is one of the largest ever used in studies of aircraft noise, the results raise serious doubts about the universality of the supposed deleterious effects of airport proximity on the prices of residential properties, and about the basis of the proposed EC ban.

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2. SIMPLE MEASURES OF THE EFFECTS OF AIRCRAFT NOISE 
NUISANCE ON RESIDENTIAL PROPERTY VALUES

The technique of hedonic price estimation, outlined in Johansson (1987), has been widely applied to estimate the effects of environmental influences on the determination of house prices.\(^1\) Walters (1975), Pearce (1978) and Nelson (1978, 1980) survey early work which used the hedonic technique to estimate the effects of aircraft noise on housing values, generally finding a small but statistically significant influence. More recent work tends to support these findings. The study by O’Byrne \textit{et al.} (1985) of Atlanta Airport finds similar rates of depreciation, but notes that the earliest work tended to find larger effects. They perceive (page 176) that an “early period of travel by commercial jet was associated with a transitional period of adjustment in residential housing markets that had essentially ended by the late 1960s”. However, not all the studies find the influence of noise, \textit{per se}, to be statistically significant. The Li and Brown (1980) study of Boston in 1971 shows that, when a variety of neighbourhood and environmental factors as well as noise pollution are added to an hedonic house price equation (resulting in 39 independent variables) the \textit{t}-ratio of the coefficient on the noise pollution variable amounts to little more than unity.

The data on housing attributes that we use in this study (excluding noise nuisance) are derived from data supplied to us by the Halifax Building Society, covering the period April 1985 to March 1986. In order to abstract as far as possible from other extraneous locational influences on property prices (such as levels of local expenditure and tax rates), we concentrate on Stockport, the main built-up area adjacent to the airport. The subset we use comprises 3,472 observations, all of which refer to actual market transactions (unlike those in many earlier studies, which consist of survey or census tract data). It is therefore one of the largest and, because it uses individual market prices, potentially one of the most accurate databases to have been used in a study of the effects of aircraft noise.

All measures of noise nuisance, as opposed to measures of noise \textit{per se}, involve some subjective analysis. The noise nuisance data we use are derived from examination of the noise contour map supplied by Manchester International Airport (Figure 1). This map was constructed during 1985, and so is reasonably contemporaneous with the data on property transactions. The contours of the map follow the Noise and Number Index (NNI), the index most commonly used in the UK. The value of 40 on this scale corresponds to the reaction of being “moderately affected by aircraft noise”, and 45 and 50 correspond to increasing degrees of being “very annoyed by aircraft noise” (see Walters, 1975). Examination of Figure 1 shows that the main area of potential noise nuisance from Manchester International Airport consists mainly of parts of five Stockport post code areas, SK9-4, SK8-3, SK8-1, SK3-0 and SK3-9. Only 12 properties in our sample fall into postcode area SK9-4; 69 are in SK8-3, 25 in SK8-1, 59 in SK3-0 and 111 in SK3-9. These last four areas are progressively closer to the built-up centre of the town. Post code area SK9-4 is the most rural of these areas, and only a relatively

\(^{1}\) See especially Harrison and Rubinfeld (1978) and, more recently, Graves \textit{et al.} (1988).
small portion of it falls within the area potentially affected by noise. Likewise only a part of area SK3-0 falls within the indicated contours of the map. We therefore concentrate on properties in the three post code areas, SK8-3, SK8-1 and SK3-9, as those most likely to be affected by noise nuisance from aircraft.²

² Various alternatives were tried. For example, all properties in SK9-4 and in SK3-0 were included in with the noise-affected group, and alternatively all properties in these two post code areas were excluded completely from the analysis. In neither case was the overall result affected. In fact the general conclusion, that the simple model is likely to lead to confusing results, was found to be supported more strongly when the properties in these areas were included with the noise-affected sample. The coefficient on the noise dummy falls from $-0.050$ (with a $t$-ratio of 3.60) in the simple model, to $-0.012$ (with a $t$-ratio of 0.94) in the final model.
We define a dummy variable to take a unit value where a property lies in these three post code areas, and add this dummy to a simple hedonic house price equation. This gives a rather crude estimate of the impact of noise nuisance. Estimating this equation gives a coefficient on the noise dummy of $-0.037$ with a $t$-ratio of $2.33$. This indicates that, ceteris paribus, properties in the postal areas most likely to be affected by aircraft noise command prices, on average, 3.7 per cent lower than those elsewhere. Other studies, such as Nelson (1980), Walters (1975) and Pearce (1978), have gone further than this and estimated the depreciation caused by a unit increase in the noise level. In order to make these estimates, a cardinal measure of noise nuisance must be derived.

The Noise and Number Index (NNI) is defined as:

$$NNI = PNdB + 15 \log N - 80$$

where $PNdB$ is the average peak noisiness of aircraft in perceived noise decibels, and $N$ is a measure of the number of aircraft heard (in the UK on a summer day). The NNI was derived from a social survey undertaken by McKennel and Hunt (1961).³

The main difficulty in deriving noise data for each sample property from the contour map is that postal districts, the only indication we have for the location of each property, do not always lie wholly within the boundary of one particular noise contour. The method we adopt then is to assign a minimum noise value to each postal district and to take the average of the highest and the lowest values for each district. For each postal district that did not lie completely within the marked NNI contours it was assumed that the minimum value would correspond to zero noise nuisance. However, because background noise is always present, zero noise nuisance will not necessarily correspond to zero on the NNI scale. The noise series that performed best when substituted for the crude dummy was based on a background noise level of 27, which, according to Walters (1975), represents zero noise nuisance in more rural areas. We thus use a series taking values varying from 27 to 40.

To be useful, any result obtained from such an index must be statistically more significant than that already noted from the crude dummy. Only this will indicate that the index is measuring some effect more than that already captured. Re-running our hedonic house price equation yielded a coefficient on the NNI variable of $-0.0047$, with a $t$-ratio of $3.34$. A property in the worst-affected area will, according to this result, suffer a reduction in value of some 6.09 per cent compared with an identical property elsewhere in Stockport. Thus the Noise Depreciation Index (NDI) (the percentage depreciation caused by a unit increase in the noise nuisance level) calculated from these data is similar to those estimated by Walters (1975), Pearce (1978) and Nelson (1980).

Further regressions were run using various sets of noise data, the different noise

³ McKennel and Hunt classified a sample of individuals in the area around Heathrow on the basis of noise levels and the number of aircraft flying overhead. The results were compared with the subjective reactions of the individuals involved. The formula derived for the NNI was regarded as providing the best fit to the McKennel and Hunt data.
AIRCRAFT NOISE AND RESIDENTIAL PROPERTY VALUES

G. Pennington et al.

series being derived by assuming different background noise levels. Each of the
other variations of the noise index also obtained a higher $t$-value than that obtained
by the coefficient of the crude dummy, but the alternative measures of noise
nuisance made virtually no difference to the coefficients on the other variables.

Proximity to an international airport will cause other micro-neighbourhood
externalities to a residential property as well as that of noise nuisance. As Li and
Brown (1980) point out, these proximity characteristics will be important partial
determinants of local property values. Like most successful airports, Manchester
International Airport is located on the outskirts of a large urban conurbation and
is served by an extensive network of motorways. Such factors will be likely to
make an area more attractive to potential residents. It can be argued that these
influences will affect Stockport in general, and that they lend further support to
concentrating the analysis on a single unified residential area. Within this, though,
account has to be taken of the fact that the airport is an employment centre, and
therefore it might be expected that housing providing easier access to the airport
would exhibit higher prices than housing not offering that accessibility, because
easier access reduces generalised travel costs. Residential properties which provide
easier access to the airport will generally be in close proximity to it and will be
exposed to higher noise levels. Any negative effect of higher noise levels may, to
some extent, be offset by the greater accessibility of noisy properties and the
possible positive effect on the prices of these properties. All this points to the
need for a more detailed analysis of the determination of residential property
values.

3. A MORE DETAILED ANALYSIS

A problem with our original equation, and with those used in most previous
studies, is that entering the number of bedrooms and living rooms as individual
cardinal measurements imposes a constant marginal valuation on these attributes.
One way of overcoming this problem is to enter number of bedrooms and number
of living rooms as series of zero/one dummy variables (0/1 dummy for 2 bed-
rooms, 0/1 dummy for 3 bedrooms, etc.). Thus the difference between the values
of the coefficients on successive dummies will give the (not necessarily constant)
proportionate valuation of the marginal room.

We therefore re-calculate our estimating equation, entering dummy variables
for zero, 1, 3, 4, and 5 or more living rooms, and dummies for zero, 1, 2, 4, 5 and
6 or more bedrooms. The results are presented in Table 1. As may be inferred
from Table 1, the excluded category is a new freehold semi-detached house with a
garden and central heating.

In addition to providing a high level of explanation, the estimated equation has
the expected signs on all the coefficients. Age is an important variable. However,
it should be remembered that the data are taken from mortgage applications, and
whereas some characteristics of the property (number of bedrooms, etc.) may be
known exactly, others, such as age, may only be known approximately. The age
variable is therefore not wholly continuous, with bunching in its distribution at
points such as 25, 30 and 50 years. Age may itself also be standing as proxy for
other aspects of the property such as size of room, location, or some other characteristic not picked up in the other variables. It is well known that in the calculation of rateable value (the assessment for local tax purposes of the rental value of a property, assuming the owner pays for repairs) considerable weight is given to age of property in the calculation of upkeep costs. Thus older properties may be expected to command much lower rate burdens, which may in turn be expected to result in their commanding higher market prices, with the effect moderating beyond a certain point. For these reasons the influence of age of property on its price may be expected to be highly complex. Various formulations of age were tried, including linear and quadratic forms. The results with squared and cubed terms reported here proved consistently to be the most significant, and this form is repeated in the final equation.

Garage spaces is also a characteristic which needs further explanation. This is a term often used by estate agents, and does not always imply simply that a property without a garage nevertheless has space for a garage to be erected. Some properties (26 in the present sample) can have both a garage and a garage space, and often the latter can be taken as a proxy for a corner plot or a large garden.

The coefficient on the month of sale gives an estimate of house price inflation in this area over the period covered by the data (April 1985 to March 1986) at an annual rate of some 10.38 per cent. Over this period the comparable rate of change of the Halifax Building Society’s national standardised index of house prices was 8.02 per cent. The Halifax only publishes regional indices on a quarterly basis, but the equivalent figure for the North West as a whole over this period was 6.53 per cent. Our estimate would thus imply a higher rate of house price inflation in the Stockport area over this period than either the national or the regional average.

Coefficients on the other variables may be interpreted directly. In general, the previous results concerning the effects of noise nuisance on the prices of residential properties around Manchester International Airport seem to hold up well in this equation.

However, a difficulty is that the specified estimating equation contains mainly variables specific to the property, and neighbourhood and environmental influences are limited to the noise variable. Nelson (1978), Freeman (1979) and Li and Brown (1980) all suggest that the influence of local neighbourhood characteristics and environmental conditions will be of crucial importance to the determination of the price of a residential property. The ways in which these influences affect each other further complicate matters. But, given these considerations, it is possible that properties in the noise-affected area command lower prices because they have neighbourhood and other locational characteristics that would make them less attractive wherever they were situated. Of the total sample of 3,472 cases, 205 were in the noise-affected area as defined above. It could be that

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4 The results here would imply that this moderation would not outweigh the initial effect unless a property was more than 600 years old, well beyond the oldest reported age in the sample.

5 The sources of these figures are the Halifax Building Society’s House Price Index, monthly National Bulletin and quarterly Regional Bulletin.
### AIRCRAFT NOISE AND RESIDENTIAL PROPERTY VALUES

**G. Pennington et al.**

#### TABLE 1

*Hedonic Price Equation with Noise Variable*

*Dependent variable = natural logarithm of price in pounds*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>10.217</td>
<td>249.71</td>
</tr>
<tr>
<td>Age-squared</td>
<td>0.041</td>
<td>8.49</td>
</tr>
<tr>
<td>Age-cubed</td>
<td>-0.072</td>
<td>5.21</td>
</tr>
<tr>
<td>No. of garages</td>
<td>0.167</td>
<td>17.02</td>
</tr>
<tr>
<td>No. of garage spaces</td>
<td>0.075</td>
<td>6.02</td>
</tr>
<tr>
<td>No central heating dummy</td>
<td>-0.114</td>
<td>13.61</td>
</tr>
<tr>
<td>No garden dummy</td>
<td>-0.117</td>
<td>6.47</td>
</tr>
<tr>
<td>Leasehold dummy</td>
<td>-0.034</td>
<td>4.30</td>
</tr>
<tr>
<td>Terraced house dummy</td>
<td>-0.168</td>
<td>15.88</td>
</tr>
<tr>
<td>Detached house dummy</td>
<td>0.351</td>
<td>28.60</td>
</tr>
<tr>
<td>Flat dummy</td>
<td>0.098</td>
<td>3.60</td>
</tr>
<tr>
<td>Bungalow dummy</td>
<td>0.359</td>
<td>22.05</td>
</tr>
<tr>
<td>0 Bedrooms</td>
<td>-0.375</td>
<td>4.35</td>
</tr>
<tr>
<td>1 Bedroom</td>
<td>-0.228</td>
<td>8.75</td>
</tr>
<tr>
<td>2 Bedrooms</td>
<td>-0.115</td>
<td>11.41</td>
</tr>
<tr>
<td>4 Bedrooms</td>
<td>0.256</td>
<td>18.82</td>
</tr>
<tr>
<td>5 Bedrooms</td>
<td>0.365</td>
<td>12.23</td>
</tr>
<tr>
<td>6+ Bedrooms</td>
<td>0.530</td>
<td>7.96</td>
</tr>
<tr>
<td>0 Living rooms</td>
<td>-0.183</td>
<td>3.02</td>
</tr>
<tr>
<td>1 Living room</td>
<td>-0.039</td>
<td>4.80</td>
</tr>
<tr>
<td>3 Living rooms</td>
<td>0.159</td>
<td>9.37</td>
</tr>
<tr>
<td>4 Living rooms</td>
<td>0.290</td>
<td>6.76</td>
</tr>
<tr>
<td>5+ Living rooms</td>
<td>0.262</td>
<td>4.26</td>
</tr>
<tr>
<td>Month of sale</td>
<td>0.008</td>
<td>7.63</td>
</tr>
<tr>
<td>NNI</td>
<td>-0.004</td>
<td>2.97</td>
</tr>
</tbody>
</table>

Mean price of sample £30,886  
\[ n = 3472 \quad \bar{R}^2 = 0.753 \]

Factors other than that of noise nuisance accounted for the differences and that, even in the absence of aircraft noise, dwellings in these areas would still command, on average, a lower price than those with the same observable characteristics but located in different and quieter parts of the town. The data do allow us to test for neighbourhood differences, as, in addition to quantifiable attributes, the database provides an indication of neighbourhood type. Using the full postcode
of the property, provided by the Halifax, CACI Market Analysis assigned to each property an ACORN\(^6\) code value. The exact derivation of the coding is outlined in CACI (1988); it is based upon some forty different census data variables evaluated by census enumeration districts, which are local areas of, on average, about 165 properties. The complete ACORN classification consists of 38 neighbourhood types, of which 31 are represented in the sub-set of the Halifax data base which we are using here. CACI's description of these 31 neighbourhood types is presented as an appendix to this paper.

A chi-squared test on the hypothesis that the distribution of neighbourhood characteristics, as measured by the ACORN classification, was the same in the three designated noise-affected areas as in the whole of the Stockport area yielded a value of 232.2. As the critical value of chi-squared at the 5 per cent confidence level with 31 degrees of freedom (there are 31 ACORN types plus an unallocated category represented in the total sample) is approximately 45, this hypothesis must be rejected. The noise-affected areas were, on the face of it, composed of a mix of neighbourhoods significantly different from that of the rest of Stockport. We therefore re-estimate the equation, now allowing for the influence of different neighbourhood characteristics, as measured by the ACORN classification. The resulting equation is presented in Table 2.

Including neighbourhood type in the equation improves its fit considerably. All but five of the 31 ACORN dummies attract coefficients which are statistically significant and which represent large proportions of the property price. Such effects clearly swamp those of the noise nuisance series, NNI. The effects on the noise variable of this improvement are immediate and dramatic. Not only is there a fall in the value of its coefficient, but its statistical significance falls to a point where the value of the coefficient is insignificantly different from zero. Again, we repeated this exercise with variations in the NNI measure and with the crude dummy. The results were similar, except that the crude zero/one noise dummy obtained a coefficient of \(-0.010\) and a \(t\)-ratio of 0.71.

These extended results appear to show that any valuation differences initially ascribed to the effects of noise nuisance can better be explained by other characteristics of the individual properties and the types of neighbourhood in which they are situated. It is, of course, possible that the neighbourhood classification used — CACI's ACORN classification — itself is measuring characteristics which may be thought of as noise-related. The chi-squared test reported above rejected the hypothesis that the neighbourhood pattern of the areas of Stockport likely to be noise-affected was the same, on average, as that of Stockport in general. However, each ACORN type represented in the noise-affected districts was also represented elsewhere in the sample. Furthermore, in no case was more than 28 per cent of a particular ACORN type found in the noise-affected districts. Therefore it appears unlikely that the ACORN classification is measuring a characteristic which is, in itself, noise-related. Put simply, the results show that,

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\(^6\) ACORN is an acronym for A Classification Of Residential Neighbourhoods; it was developed by the Market Analysis Division of CACI. Its main use is in target area marketing, as it classifies residential areas both by their housing characteristics and by the social characteristics of their residents.
AIRCRAFT NOISE AND RESIDENTIAL PROPERTY VALUES

G. Pennington et al.

TABLE 2

Hedonic House Price Equation with Noise Variable and Separate ACORN Dummy Variables

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coefficient</th>
<th>t-ratio</th>
<th>Predictor</th>
<th>Coefficient</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>10.244</td>
<td>271.34</td>
<td>ACORN 1</td>
<td>0.315</td>
<td>4.30</td>
</tr>
<tr>
<td>Age squared</td>
<td>0.041</td>
<td>9.98</td>
<td>ACORN 2</td>
<td>0.364</td>
<td>3.27</td>
</tr>
<tr>
<td>Age cubed</td>
<td>-0.072</td>
<td>6.30</td>
<td>ACORN 3</td>
<td>-0.182</td>
<td>9.31</td>
</tr>
<tr>
<td>Garage</td>
<td>0.141</td>
<td>15.99</td>
<td>ACORN 4</td>
<td>-0.139</td>
<td>8.26</td>
</tr>
<tr>
<td>Garage space</td>
<td>0.051</td>
<td>4.52</td>
<td>ACORN 5</td>
<td>-0.079</td>
<td>5.27</td>
</tr>
<tr>
<td>No garden</td>
<td>-0.084</td>
<td>5.14</td>
<td>ACORN 6</td>
<td>0.007</td>
<td>0.38</td>
</tr>
<tr>
<td>Leasehold</td>
<td>-0.020</td>
<td>2.84</td>
<td>ACORN 7</td>
<td>-0.104</td>
<td>4.77</td>
</tr>
<tr>
<td>No central heating</td>
<td>-0.101</td>
<td>13.42</td>
<td>ACORN 8</td>
<td>-0.159</td>
<td>8.75</td>
</tr>
<tr>
<td>Terraced house</td>
<td>-0.131</td>
<td>13.36</td>
<td>ACORN 9</td>
<td>-0.080</td>
<td>3.41</td>
</tr>
<tr>
<td>Detached house</td>
<td>0.297</td>
<td>26.50</td>
<td>ACORN 10</td>
<td>-0.215</td>
<td>15.89</td>
</tr>
<tr>
<td>Flat</td>
<td>0.001</td>
<td>0.06</td>
<td>ACORN 11</td>
<td>0.246</td>
<td>15.66</td>
</tr>
<tr>
<td>Bungalow</td>
<td>0.315</td>
<td>21.58</td>
<td>ACORN 12</td>
<td>-0.329</td>
<td>5.81</td>
</tr>
<tr>
<td>0 Bedrooms</td>
<td>-0.380</td>
<td>4.94</td>
<td>ACORN 13</td>
<td>-0.297</td>
<td>3.04</td>
</tr>
<tr>
<td>1 Bedroom</td>
<td>-0.223</td>
<td>9.55</td>
<td>ACORN 14</td>
<td>-0.117</td>
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</tr>
<tr>
<td>2 Bedrooms</td>
<td>-0.113</td>
<td>12.58</td>
<td>ACORN 15</td>
<td>-0.276</td>
<td>4.93</td>
</tr>
<tr>
<td>4 Bedrooms</td>
<td>0.228</td>
<td>18.63</td>
<td>ACORN 16</td>
<td>-0.176</td>
<td>8.26</td>
</tr>
<tr>
<td>5 Bedrooms</td>
<td>0.366</td>
<td>13.66</td>
<td>ACORN 17</td>
<td>-0.269</td>
<td>11.95</td>
</tr>
<tr>
<td>6+ Bedrooms</td>
<td>0.446</td>
<td>7.48</td>
<td>ACORN 18</td>
<td>-0.184</td>
<td>3.89</td>
</tr>
<tr>
<td>0 Living rooms</td>
<td>-0.217</td>
<td>4.02</td>
<td>ACORN 19</td>
<td>-0.198</td>
<td>5.86</td>
</tr>
<tr>
<td>1 Living rooms</td>
<td>-0.033</td>
<td>4.43</td>
<td>ACORN 20</td>
<td>-0.205</td>
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</tr>
<tr>
<td>3 Living rooms</td>
<td>0.119</td>
<td>7.87</td>
<td>ACORN 21</td>
<td>-0.210</td>
<td>5.14</td>
</tr>
<tr>
<td>4 Living rooms</td>
<td>0.230</td>
<td>6.01</td>
<td>ACORN 22</td>
<td>-0.448</td>
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</tr>
<tr>
<td>5+ Living rooms</td>
<td>0.236</td>
<td>4.31</td>
<td>ACORN 23</td>
<td>-0.009</td>
<td>0.31</td>
</tr>
<tr>
<td>Month of sale</td>
<td>0.008</td>
<td>8.54</td>
<td>ACORN 27</td>
<td>-0.015</td>
<td>0.08</td>
</tr>
<tr>
<td>NNI</td>
<td>-0.0015</td>
<td>1.16</td>
<td>ACORN 30</td>
<td>-0.115</td>
<td>7.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ACORN 31</td>
<td>0.040</td>
<td>2.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ACORN 32</td>
<td>0.212</td>
<td>6.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ACORN 33</td>
<td>0.157</td>
<td>9.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ACORN 34</td>
<td>0.034</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ACORN 35</td>
<td>-0.032</td>
<td>0.62</td>
</tr>
</tbody>
</table>

\( n = 3472 \quad \overline{R^2} = 0.802 \)

whereas properties in the noise-affected areas of Stockport do command lower market prices, this can be explained by factors other than that of noise. Similar houses in the same types of neighbourhood elsewhere in Stockport without noise nuisance would command essentially similar prices.
CONCLUSIONS

The differences in value between residential properties are the result of a wide spectrum of different characteristics of the properties, the neighbourhood, and the environment. For the Stockport area, initial estimates suggested that properties in the parts of the town most affected by noise from the nearby Manchester International Airport are affected to the extent that their market value is reduced by, on average, over 6 per cent. However, it is only when all other possible differences are accounted for that one can truly be said to contrast a noise-blighted property with a comparable property which is not noise-blighted. The results for Stockport do appear to show that, when other factors are as far as possible allowed for, any resulting differences which could be attributed to the effects of noise are statistically insignificant. Properties which are in areas affected by the noise of aircraft using Manchester International Airport do appear to have lower market values than those in other parts of Stockport. But, in effect, the whole of this difference can be attributed to neighbourhood and other characteristics of the properties: they could still be expected to command lower prices even if they were not under the flight path of aircraft using the airport.

The study clearly shows that any attempt to measure the effects of noise on house prices without at least trying to allow for neighbourhood and structural factors is likely to mis-state grossly the effects of noise on property values. Above all, the study raises questions about future aircraft noise controls outlined in the recent EC Directive and scheduled for implementation in November 1990.

APPENDIX

CAI's ACORN Classifications, Represented in the Sample

1 Agricultural villages.
2 Areas of farms and smallholdings.
3 Cheap modern private housing.
4 Recent private housing, young families.
5 Modern private housing, older children.
6 New detached houses, younger families.
7 Mixed owner-occupied and council estates.
8 Small town centres and flats above shops.
9 Villages with non-farm employment.
10 Older private housing, skilled workers.
11 Unimproved terraces with older people.
12 Pre-1914 terraces, low income families.
13 Tenement flats lacking amenities.
14 Council estates, well-off older workers.
15 Recent council estates.
16 Council estates, well-off young workers.
17 Low rise estates in industrial towns.
18 Inter-war council estates, older people.
19 58
AIRCRAFT NOISE AND RESIDENTIAL PROPERTY VALUES

G. Pennington et al.

21 Council housing for the elderly.
22 New council estates in inner cities.
23 Overspill estates, high unemployment.
27 Owner-occupied terraces with Asians.
30 High status areas, few children.
31 Multi-let big old houses and flats.
32 Furnished flats, mostly single people.
33 Inter-war semis, white collar workers.
34 Spacious inter-war semis, big gardens.
35 Villages with wealthy older commuters.
36 Detached houses, exclusive suburbs.
37 Private houses, well-off elderly.
38 Private flats with single pensioners.

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REFERENCES