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IDENTIFYING DETERMINANTS OF RESIDENTIAL PROPERTY VALUES IN SOUTH LONDON

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Abstract: This paper advances the academic work conducted on identifying some of the determinants of residential property values in different countries. Such determinants might include positive factors such as access to amenities, or negative factors such as high voltage overhead transmission lines (HVOTL). The objective explored here is to extend this research in the UK by considering the particular case of residential property values in South London. A number of determinants is considered, grouped and a model which explains the effect of the determinants on value is produced. The elasticities between property values and the distances from different determinants were also analysed to help highlight relationships between the determinants and residential property values. The results showed a relationship between residential property values and the determinants, and a relationship between the determinants themselves.

Key words: House characteristics, amenity places, house value, modelling residential house price, cross elasticities

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Introduction[2]

A number of academic works have been published with the objective of identifying the main factors determining residential property values. These determinants can be categorised into four groupsthat are outlined and discussed below:

House characteristic factors such as number of rooms, central heating and land area were found by Bourassa et al. (2010) to positively affect property values; to some extent, this is common sense.

Psychological and health factors might include proximity to linear infrastructure such as high voltage overhead transmission lines (HVOTL) as these factors could negatively affect property values. For example, Gregory and Winterfeldt, (1996) demonstrated that the proximity to HVOLT can produce negative psychological effects on residents. This psychological impact was investigated more fully in an American study by Priestley and Evans (1996) who found out that HVOTL made a negative impression on those individuals living within a 'wide radius.' It was also argued that electromagnetic frequencies could produce negative health effects (Jayne, 2008). This was confirmed by Fews et al. (1999) who demonstrated an increased deposition of harmful aerosols under 400kv and 275kv lines. Debrezion et al. (2006) found a negative effect of distance to railways on property values, which they say is probably due to noise effects.

Aesthetic factors might include either infrastructure such as HVOTL, or amenity factors such as parks. Across Europe and the North American continent, it has been recognised that to a certain degree, HVOTL do de-value properties located nearby (Kroll and Priestley, 2008). In contrast, properties located near amenity places have been found to have higher values. For example, Giaccaria and Frontuto (2007) learnt that values of properties near protection areas (similar to an AONB in the UK), and public parks were higher. Likewise, the results obtained by Poudyal et al. (2008) revealed that urban recreation park acres increased nearby property values.

Finally, regarding service opportunity factors, Debrezion et al. (2006) found a positive effect of distance to rail stations on property values and Des Rosiers and Thériault (2006) discovered that proximity to some roads also positively affected house values.

In order to investigate the effects of house characteristic factors, health and psychological factors, aesthetic factors, and service opportunity factors on house values in different countries, researchers have often developed hedonic models.[3] However,

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[3] Hedonic method is defined by Des Rosierset al. (2001) as the "tool for untangling the cross-

little attempt has been made within the UK to determine how public perception, particularly of the latter three factors, translates into lower property values (Sims and Dent, 2005). The few existing studies have been focused on particular areas in the UK. For example, Sims et al. (2009) provided evidence to support the relationship between value diminution and the presence of a HVOTL near residential homes in Walmley (near Sutton Coldfield, North Birmingham) and St Peter the Great (South of Worcester), building upon the work conducted near Glasgow by Sims and Dent (2005).

It is difficult to generalise these findings to a national level, particularly as no conclusive result has been found in related investigations conducted in different countries. For example, Colwell (1990) constructed a hedonic price index for residential property in Illinois, USA, based on a number of property variables and found out that HVOTL had a negative effect on land values. In contrast, Bond and Hopkins (2000) found that HVOL had no significant effect on residential property values in an area of Wellington, New Zealand. These examples suggest that perception of health and psychological factors, aesthetic factors, and service opportunity factors depends upon the particular location under consideration and this, in turn, translates into different property valuations.

The objective of this article is to extend the research in the UK by analysing the particular case of residential property values in South London. For this purpose, a hedonic multiple regression model based on the works of Colwell (1990), Bond and Hopkins (2000), and Gupta and Mythili (2010) has been adopted. Our work also contributes to this research by introducing cross elasticities in order to identify interactions among variables. To the best of our knowledge, this is the first academic work that has considered eslaticities in this way.

Methods

The sold price data for 1,251 houses, over a nine year period from April 2000 was collected for a 1.15km² area of Welling, South London. The data was obtained from Nethouseprices (2009), which is a free statistical source reporting data directly from the Land Registry. These house values were then indexed up to today's value (Quarter 1, 2009), using the Nationwide house price index (Nationwide, 2009). This index was chosen as it provides a 'Greater London area' option, which suits our study area. Each property was then identified using the Edina Digimap 'Carto' facility, and the closest distances between each property sold and various determinants of the locality. Due to the sometimes long distances involved, and to enable the work to be repeatable, criteria for measurement points and accuracy were established and adhered to during the study. This study area has two particular advantages: it contains many of the determinant factors, and the housing stock is broadly homogenous, having largely all been built in the 1930s as part of a single major development. The research considered a number of potential factors that could affect residential values which were available in the public domain. The determinants used are described as follows:

(i) House characteristic factors: Separate dummy variables were defined and used to represent house characteristics. They included: tenure (i.e. whether the property was

influences between the numerous dimensions affecting property values and for establishing the implicit price of individual residential attributes (p. 150)".

freehold or leasehold; property type (i.e. whether the property was detached - define as a free-standing residential building, semi-detached - defined as a pair of houses built side by side sharing a single side wall, terraced - defined as row of identical houses sharing side walls, or a flat - defined as self-contained housing unit occupying only part of a building); plot over-sail (i.e. whether the plot was directly over-sailed by HVOTL); house over-sail (i.e. whether the house was directly over-sailed by HVOTL); and plot tower (i.e. whether there was a pylon actually on the property).

(ii) Health and psychological factors: The factors or variables included in this group were distance to a centre line of HVOTL (*DCL*); distance to the nearest pylon (*DPY*); and distance to railway lines (*DRA*).

(iii) Aesthetic factors: Only one variable was included in this group and corresponded to distance to public park (*DPK*).

(iv) Service opportunity factors: Only one variable was included in this group and corresponded to distance to Welling station (*DWS*).

All the distance variables were measured in metres. A hedonic multiple regression model was adopted to determine the effects of these variables on residential property values in the study area (see Colwell, 1990; Bond and Hopkins, 2000; and Gupta and Mythili, 2010). The model has been specified as follows:

$$\begin{aligned} LnP &= \beta_0 + B_1 Lasehold + \beta_2 Terraced + \beta_3 Semi\det ached \\ &+ \beta_4 Flat + \beta_5 Plot(house)Oversail + \beta_6 PlotTower \\ &+ \beta_7 LnDCL + \beta_8 LnDPK + \beta_9 LnDRA + \beta_{10} LnDWS \\ &+ \beta_{11} LnDPY + \sum_i \sum_j \beta_{ij} LnD_i * LnD_j \end{aligned} \qquad (1)$$

where *P* represents house value and *LnX* denotes the natural logarithm of variable *X*. The non-dummy variables (i.e. house values and distance variables) were all expressed as natural logarithms in order to capture non-linearity (Colwell, 1990). This also permitted the estimation of elasticities between property values and the distances from different determinants considered in the research. Finally, the last cross term on the right-hand side of the equation was introduced with the objective of capturing interaction between the distance variables. In this formulation, *Di* and *Dj* are generic expressions of the variables in the set {*DCL; DPK; DRA; DWS; DPY*}. Interactions among variables were estimated by means of cross elasticities. Appendix A explains how these elasticities were obtained.

In order to determine the effects of the distances between the four determinants and house values, the model described in Expression 1 was estimated using Ordinary Least Squares. Because this model includes dummy variables, this regression is referred to as least squares dummy variable (LSDV) regression. A perfect multicollinearity is potential problem arising from LSDV (see Park, 2009; and Suits, 1957). In order to avoid this problem, a dummy variable for each category was dropped. To determine whether the multicollinearity problem was avoided using this strategy, collinearity was assessed using auxiliary regressions. According to Hill et al. (2008), detrimental collinearity is present when the coefficients of determination of these regressions are equal to or higher than 0.80. Because the coefficients of determination of the auxiliary regressions estimated in this research were lower than 0.80, it was concluded that detrimental collinearity was not present in the model. The auxiliary regressions are shown in Appendix B. Finally, The Goldfeld-Quandt test was used to test heteroscedasticity. For this purpose, the n observations in the sample were ordered by the magnitude of P and separate regressions were run for the first 469 and the last 469 observations. The residual sum of squares in the two sub-regressions was used to obtain the ratio test *RSS2/RSS1* (i.e. the Goldfeld-Quandt test) where *RSS1* and *RSS2* are the residual sum of squares of the first and second sub-regression, respectively (see Dougherty, 2007, p. 229). The values of *RSS1* and *RSS2* obtained from the sub-regressions were 5.23 and 6.35, respectively. Using this test, heteroscedasticity was rejected at the 10% of significant level, but not at the 5%. As a consequence, the results obtained in this investigation have to be considered with caution.

The estimation of the model described in Equation 1 is presented in Table 1, and the relevant elasticities are presented in Table 2.

Table 1: Hedonic multiple regression estimation

Variable	Coefficient	t-statistic	p-value
Intercept	9.54	12.26	0.000
Terraced	-0.12	-4.63	0.000
Semi-detached	-0.08	-3.48	0.005
Leasehold	-0.19	-2.22	0.027
Flat	-0.33	-373	0.002
LnDCL	0.03	3.63	0.003
LnDPK	1.08	5.98	0.000
LnDRA	0.87	5.53	0.000
LnDWS	-0.89	-7.77	0.000
*LnDRA*LnDPY*	-0.05	-5.37	0.000
*LnDRA*LnDPK*	-0.09	-4.99	0.000
*LnDWS*LnDPY*	0.11	6.19	0.000
*LnDPY*LnDPK*	-0.08	-6.10	0.000
Adjusted R^2 0.44			
S.E. of regression 0.17			

Table 2: Elasticities of house’s value and distance variables

Elasticity		Value
$\partial LnP/\partial LnDCL$	=	0.03
$\partial LnP/\partial LnDPK$	=	1.08 – 0.09**LnDRA* – 0.08**LnDPY*
$\partial LnP/\partial LnDRA$	=	– 0.05**LnDPY* – 0.09**LnDPK*
$\partial LnP/\partial LnDWS$	=	– 0.89 + 0.11**LnDPY*

The model presented in Table 1 reveals that property values are affected by different house characteristics. Leasehold was shown to have a negative effect on value, however this result has to be considered with caution as this indicator needs to be contextualised with the other characteristics and the data considered by the model. For example, it is possible to demonstrate that by keeping all the distance variables constant, a freehold flat is less expensive than leasehold semi-detached house. Whilst it is common sense that most flats are worth less than houses of any type; a freehold flat is most unusual, as it would have to be in contact with the ground to be registered as freehold. Therefore, a clear picture of the way in which house characteristics affect property values depends upon how these characteristics are combined, and the legal realities of home ownership in England and Wales.

Table 2, on the other hand, shows that house values increases by 0.03% when the distance to the centre line of HVOLT (*DCL*) increases by 1%. This result is consistent with that obtained by Sims et al. (2009) and Sims and Dent (2005). That is, this evidence supports the existence of a relationship between value diminution and the presence of an HVOTL near residential properties. Table 2 also shows that the relationship between proximity to public parks (*DPK*) and property values is relative as it depends on the interaction between proximity to public parks, railway lines (*DRA*) and pylons (*DPY*). For example, the elasticity between house values and DPK is equal to -0.16 for houses located 1,500 metres from railway lines and pylons. For this set of houses, proximity to public parks increases the value of residential properties. In contrast, the elasticity for houses located 500 metres from these infrastructures is 0.02 indicating that proximity to public parks decreases the property value for this set of houses. It could be inferred from this result that the beneficial effects of proximity to a public park disappears in the presence of railway lines and pylons. This finding is consistent with that obtained by Giaccaria and Frontuto (2007). In synthesis, residents in South London did not consider public parks as an isolate amenity attribute when purchasing residential properties but as an element within a more complex system that involves a number of interactions. A similar result has been observed in the case of proximity to railway lines; here the way in which they affect residential property values depends upon the interaction between the lines and the proximity to pylons and public parks. Finally, Table 2 shows that an interaction exists between proximity to Welling station (*DWS*) and pylons. For example, the elasticity between house values and *DWS* is equal to 0.01 for houses located 3,500 metres from pylons. In contrast, this elasticity is equal to -0.21 for houses located 500 metres from the pylons. This finding suggests that any loss of value caused by the presence of pylons is partially offset when a transport service is available.

Conclusions

The present investigation used a hedonic model to identify the effect of a number of determinants on residential property values in South London. The results revealed that these values were negatively affected by closeness to HVOTL and by house attributes such as where they were part of a terrace. In contrast, detached houses had higher value. The existence of an interaction was also found between some determinants, which resulted in an ambiguous effect upon house values. For example, proximity to public parks had only a positive effect on property values for houses located far away from pylons and railway lines; however, this effect was not verified for houses located near the determinant. In contrast, proximity to Welling station had only a positive effect on property values for houses located near pylons suggesting that the loss of value caused by the presence of the latter was partially offset by the proximity to this determinant.

The introduction of elasticities and hence interactions into the analysis is the novelty of our study. The consideration of interactions revealed that the effect of proximity to key infrastructures is ambiguous and depends on the relative position of houses in the infrastructure system. It is for this reason that related works, conducted without the introduction of these interactions have to be considered with caution.

It would be interesting to explore how these interactions operate in other areas of London. This would provide the opportunity to compare how motivations of different types of residents (grouped by level of income for example) translate into different property valuations. We leave this extension for future research.

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Appendix A

Cross Elasticities

Consider the following simplified version of the model presented in Equation 1:

$$LnP = \beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_1 * LnX_2 \quad (1A)$$

In this expression, the elasticities of the variable P with respect to variables X_1 and X_2 can be obtained by taking the partial derivatives of LnP with respect to LnX_1 and LnX_2, respectively. These elasticities correspond to:

$$\partial LnP / \partial LnX_1 = \beta_1 + \beta_3 LnX_2 \quad (2A)$$

$$\partial LnP / \partial LnX_2 = \beta_2 + \beta_3 LnX_1 \quad (3A)$$

Appendix B

Auxiliary Regressions

Regression	R^2
(1) *LnDCL* = 25.59 – 0.84*Leasehold* + 0.14*Terraced* + 0.40*Semidetached* + 1.25*Flat* + 0.02*LnDRA* – 1.86*LnDST* – 1.34*LnDPK*	0.66
(2) *LnDRA* = 5.00 + 0.27*Leasehold* + 0.33*Terraced* + 0.49*Semidetached* – 0.43*Flat* + 0. 0.02*LnDCL* + 0.60*LnDST* – 0.53*LnDPK*	0.33
(3) *LnDST* = 9.44 – 0.04*Leasehold* + 0.30*Terraced* + 0.17*Semidetached* + 0.18*Flat* – 0.21*LnDCL* + 0.07*LnDRA* – 0.37*LnDPK*	0.57
(4) *LnDPK* = 15.01 – 2.75*Leasehold* + 0.43*Terraced* + 0.43*Semidetached* + 0.31*Flat* - 0.38*LnDCL* – 1.16*LnDRA* – 0.92*LnDST*	0.69

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