C Effect of heritage listing: a hedonic study of two local government areas

Historic heritage is of importance to many in the community and all Australian governments have heritage-specific legislation to list and protect identified heritage features. However, there is much debate over the effect heritage listing has on property values. Empirical evidence differs on this. On the one hand, individual valuation reports tend to indicate a loss on some properties of up to $500 000 resulting from the extra development restrictions imposed (sub. DR202). On the other hand, some studies conclude that heritage listing adds value. For example, the Australian Heritage Directory states that one Sydney hedonic price study shows that heritage listing boosts house prices by 12 per cent.[1] This figure was quoted to the Commission several times over the course of the inquiry. The NSW Heritage Office (sub. 188) argued that property losses have not been demonstrated and independent studies have shown that heritage listing results in increased property values.

There have been several studies attempting to estimate the price effect of heritage listing. Armitage and Irons (2005) provide an extensive review of the literature. Three 'approaches' were identified. The majority of studies used repeat-sales techniques, which compare over time, the sale prices of heritage and non-heritage properties. Meese and Wallace (1997) demonstrate that this technique is less accurate and more susceptible to data problems than hedonic modelling.

Several studies have used hedonic price modelling to estimate the price effect of heritage listing. Ford (1989) and Asabere et al. (1989) examined the price effect of heritage zones and came to different conclusions. Ford (1989) concluded that designation of a heritage zone increased house prices, whereas Asabere et al. (1989) did not find any significant price effect. Scaeffer and Millerick (1991) estimated that heritage designation had a negative effect on house prices, while a more recent Australian study (Deodhar 2004) found that heritage listing in the Ku-ring-gai local government area (LGA) in Sydney had a positive effect on price.

The aim of this appendix is to examine the effect heritage listing has on the value of residential single-dwelling property in two Sydney local government areas noted for containing historic heritage: Ku-ring-gai and Parramatta. The Parramatta LGA,

[1] http://www.heritage.gov.au

Australia's first seat of government, was chosen for its high level of heritage places and as being representative of urban sprawl development pressures. The Ku-ring-gai LGA, as well as being the 'home' of the National Trust movement, is one of the leading local governments in the protection of twentieth century buildings. Ku-ring-gai has also been subject to a previous hedonic study (Deodhar 2004).

C.1 Hedonic modelling

The basic assumption underpinning hedonic modelling is that the market price of a good is dependent on the characteristics of that good (including non-market characteristics). With respect to housing, this assumption implies that a house is a bundle of size, quality, and location characteristics. Hedonic modelling seeks to explain (by making comparisons) the value of a house in terms of its individual characteristics. In this regard, each characteristic is valued (Malpezzi et al. 1980; Kain and Quigley 1970; Boyle and Kiel 2001). For example, if there are two houses in the same location within a competitive housing market, and the only difference between the two is that one has three bathrooms and the other has two, then the difference in price between the houses is taken to reflect the value of the extra bathroom. Where several attributes differ, the comparisons are not as straight forward and estimation techniques, such as multivariate regression analysis, are used to isolate the individual influence and value of each characteristic. Malpezzi et al. state:

> The estimated regression coefficients are implicit prices which measure the value of each dwelling and neighbourhood characteristic. For example, the regression might determine that a central heating system adds 10 per cent to the value of a house. (1980, p. 11)

Hedonic price modelling not only identifies the value of individual attributes of a product, it can also identify the willingness to pay for non-market attributes. This is demonstrated by the difference between prices of goods that have different non-market attributes, when holding all other attributes constant.

The following is the general hedonic model:

$$P_i = P(S_{i1},...,S_{ij},N_{i1},...,N_{ij};u_i) \quad (1)$$

where P_i = observed price of commodity i

S_{ij} = structural characteristic j per unit of commodity i

N_{ij} = neighbourhood characteristic j per unit of commodity i

u_i = a disturbance term (Lucas 1975, p. 157).

C.2 Hedonic modelling of housing attributes

There are numerous studies estimating hedonic price equations for housing that focus on a varied selection of structural, locational and non-market characteristics. Kain and Quigley comment:

> [the] difficulty in measuring the physical and environmental quality of the dwelling unit and surrounding residential environment is perhaps the most vexing problem encountered in evaluating the several attributes of bundles of residential services. (1970, p. 533)

When estimating the value of characteristics, it is important to ensure that the relevant market is defined correctly, as each separate housing market may value characteristics differently and result in differing hedonic equation (Sirmans et al. 2005). For example, central heating may be valued more in Canberra than in Brisbane. A hedonic equation which spans several markets may produce biased estimates. Malpezzi et al. (1980) use metropolitan areas as markets, although they account for several sub-markets using dummy variables (e.g., different sub-markets for city and country houses).

Hedonic modelling has no strong theoretical preference for a particular functional form. Typically, most hedonic regressions use a log-linear (semi-log) functional form as it has several interpretational advantages over a liner functional form.

The first advantage is that the semi-log form allows for the value of an attribute to vary according to the other characteristics in the house. For example, the semi-log model allows air conditioning to be worth different amounts for a three bedroom and a six bedroom house. A linear model would estimate the same value for air conditioning irrespective of the other characteristics.

Use of the semi-log form also allows for more intuitive interpretation of a variable's coefficient. The coefficient of a variable can be interpreted as the percentage change in the value of the house given a unit change in the variable.

Independent variables, under the semi-log functional form, are typically entered as dummy variables. This enables maximum flexibility in the model. If independent variables were entered as true values, then the model would be forcing the same value on all units — for example, bedrooms where intuition indicates that buyers may value the third and sixth bedroom differently. Where dummy variables are used, the coefficients of the variables can be interpreted as the percentage change in the value of the house due to the presence of that characteristic.

A wide variety of independent variables could be included in estimating hedonic prices for housing. Typically, they can be broken down into structural and

neighbourhood/locational variables. The variables used will inevitably be influenced by the hypothesis being tested — and data limitation. For example, one could use a Postcode variable as a broad indication of location and/or neighbourhood characteristics. This would be appropriate where the hypothesis does not seek to analyse the influence of each individual neighbourhood or location variable. Generally, the number, detail and type of variables included are limited by the available data.

Hedonic studies testing hypotheses regarding locational factors (which also usually measure the effect of environmental features such as landfill or pollution), typically provide more detailed locational and neighbourhood characteristics (see, for example, Din et al. 2001; and Hite et al. 2001) than studies that focus on actual real estate prices. Studies that estimate house prices concentrate on structural features, with only broad-level locational variables used (see, for example, Grether and Mieszkowski 1974; Malpezzi et al. 1980; and Chowhan and Prud'homme 2004).

Structural variables should represent aspects of the actual house that relate to size, use and quality. The most common structural variables are: land size; number of bedrooms; size of the house; age; and the number of bathrooms (Sirmans et al. 2005, p. 9). Dummy variables are included for other types of rooms — either generally (e.g., other types of rooms) or specifically (e.g., dummy variables for rumpus and lounge rooms). Where available, specific quality indicators such as roof leaks, holes or cracks in internal surfaces, and level of privacy can be included. Most hedonic equations do not contain this level of detail due to data constraints.

The most common internal characteristics used in hedonic modelling are:

- full bathroom;
- half bathroom;
- fireplace;
- air-conditioning;
- timber floor; and
- basement (Sirmans et al. 2005, p. 9).

The most frequently used external characteristics are:

- garage/number of car spaces;
- deck;
- porch;
- pool; and

- carport (Sirmans et al. 2005, p. 9).

Neighbourhood (or location) variables typically are a mix of subjective opinions of the area (such as whether the street is a 'desirable' street) and objective criteria (such as crime rate, distance to school and public transport). Malpezzi et al. (1980, p. 30) focused primarily on subjective neighbourhood characteristics, such as: households' rating of their street; presence of abandoned houses in street; and litter on the street. Sirmans et al. (2005, p. 10) noted that location was generally identified using postcodes. Crime rate, golf course, trees and distance from the central business district were also commonly used variables. Other environmental variables typically used include a good view, lake or ocean view and water frontage.

C.3 Estimating the price of heritage listing for selected local government areas

For this hedonic model, data were obtained from RP Data Ltd.[2] RP Data is the largest supplier of real estate data in Australia and New Zealand. Their services include detailed sales histories for properties searchable by LGA.

Sales data were obtained for the two chosen LGAs studied (Parramatta and Ku-ring-gai) for the financial year 2004-05. For each property sold during this period, RP Data provided a description of the property (number of bedrooms, bathrooms, other rooms, pool, renovated, etc), land size, zoning, land use and photos. Only properties that included sufficient detail were included in the modelling.

The structural variables collected for both the Parramatta and Ku-ring-gai hedonic equations were:

- number of bedrooms;
- number of bathrooms;
- car spaces;
- area of block of land;
- whether the house had two stories;
- rumpus room;
- recently renovated;
- pool;
- tennis court; and

[2] http://www.rpdata.net.au

- open plan.

These structural variables, except for area of block, were generally included as dummy variables. For example, the pool variable was either 1 or 0, with 1 representing the presence of a pool. Separate dummy variables were set up for the number of bedrooms (bed1, bed2, bed3, bed4, etc). However, for some structural variables, the actual number was included as this provided a better fit in the model.

Locational variables were taken into account through the use of Postcode dummy variables. As the focus of this hedonic model is the value of heritage listing, detailed locational variables were not required. Additionally, the 'desirableness' of a suburb and detailed locational variables, such as crime rates, can only be included on a suburb by suburb basis. Accordingly, the Postcode variable acts as a proxy for these more detailed factors.

Hedonic equation for Parramatta LGA

The Parramatta hedonic equation included 578 observations. That is, there were 578 sales during the financial year 2004-05 for which sufficient detail was available. Of these 578 houses, 20 were listed (3.5 per cent) as being of 'local heritage significance'. The mean sale price for all properties sold during the sample period was $495 800. The mean block size was 626 m^2. The mean number of bedrooms was 3.1 and the mean number of bathrooms was 1.4.

The mean sale price of the 20 heritage-listed properties during the sample period was $613 600, some 24 per cent higher than the mean for all properties sold. The mean land size for heritage-listed properties was 629 m^2. The mean number of bedrooms was 3 and the mean number of bathrooms was 1.4.

As shown in table C.1, two hedonic price equations were calculated, one with just structural variables and one with structural and locational variables. The goodness-of-fit estimate, R-squared, of the structural-only model was 0.48. When the locational variables were added the R-squared increased to 0.72 and significant changes occurred in the estimates of all structural variables except for garaging. This indicates that locational variables play an important role in determining the value of property in the Parramatta LGA and that regressing the influence of most structural characteristics without accounting for them is fraught with error. The R-squared estimates are consistent with other hedonic regressions (see, for example, Sirmans et al. 2005; Malpezzi et al. 1980).

In regard to the first regression, which contained only structural variables, the size of the block of land (in 100 m^2) was included, as were dummy variables for the third, fourth and above bedrooms. Dummy variables were also included for the

second and third or more bathrooms. The presence of a pool, undercover garaging for one and two cars, a second storey and a renovated interior were also included in this hedonic equation. In the absence of locational variables, block size, four or more bedrooms, second bathroom, third and more bathroom, undercover garage for two cars, and renovation were statistically significant.

Table C.1 **Parramatta hedonic price equations**

Variable	*Coefficient without location variables*	*Percentage effect on price*	*Coefficient with locational variables*	*Percentage effect on price*
R-squared	0.48	..	0.72	..
Constant	5.603**	..	5.689**	..
Area (100 m^2)	0.067**	6.9	0.048**	4.9
Bed 3	0.021	2.1	0.042*	4.3
Bed 4 plus	0.091**	9.5	0.105**	11.1
Bathroom 2	0.076**	7.9	0.042**	4.3
Bathroom 3 plus	0.136**	14.6	0.085**	8.9
Pool	0.026	2.6	0.054**	5.5
LUG 1	0.023	2.3	0.024+	2.4
LUG 2 plus	0.069**	7.1	0.064**	6.6
Second storey	0.020	2.0	0.049*	5.0
Renovation	0.157**	17.0	0.077**	8.0
Heritage	**0.086***	**9.0**	**0.019**	**1.9**
PO 2115	..	..	0.058**	6.0
PO 2116	..	..	0.068	7.0
PO 2117	..	..	0.111**	11.7
PO 2118	..	..	0.037	3.8
PO 2121	..	..	0.386**	47.1
PO 2122	..	..	0.302**	35.3
PO 2142	..	..	-0.064**	-6.2
PO 2145	..	..	-0.088**	-8.4
PO 2146	..	..	-0.120**	-11.3
PO 2150	..	..	0.091**	9.5
PO 2151	..	..	0.127**	13.5
PO 2152	..	..	0.038	3.9
PO 2160	..	..	0.059	6.1
PO 2161	..	..	-0.086**	-8.2

** Significant at the 1 per cent level. * Significant at the 5 per cent level. + Significant at the 10 per cent level. **PO** Postcode.

Sources: RP Data Ltd, Commission estimates.

The inclusion of locational variables in the second regression had a significant effect on the estimates from the model. This could be due to the diverse area covered by` the Parramatta LGA. The effect of location on housing value was quite significant, with the two most expensive suburbs, Eastwood and Epping, adding 35 and 47 per cent respectively to the value of an equivalent house in the base suburb (Baulkham Hills) — these two suburbs also contained 40 per cent of heritage-listed properties. Ten of the 14 Postcode dummy variables in the Parramatta LGA were significant at the 1 per cent level. All structural variables in this model were statistically significant — third bedroom and second storey at the 5 per cent level, garaging for one car at the 10 per cent level and all others were significant at the 1 per cent level.

Heritage was represented by a heritage dummy variable (taking the value of 1 when heritage listed and 0 if not). A comparison of the two estimated hedonic models indicates that the heritage variable captured a strong locational effect. Without accounting for location (i.e., regression without Postcode variables), heritage listing was estimated to add some 9 per cent to the value of a house (and was significant at the 5 per cent level). After including locational variables, the estimate of heritage value reduced to 2 per cent and was not statistically significant.

The hedonic price equations indicated that the value of housing within the Parramatta LGA depends upon location and structural variables, such as the number of bedrooms and bathrooms, land size, amount of garage space and whether the house has been recently renovated. Importantly, the hedonic price equations demonstrate that the heritage listing of a property has a statistically insignificant effect on its value when account is taken of the differences in locational and structural composition of properties. The null hypothesis that heritage-listing does not affect the value of housing in the Parramatta LGA cannot be rejected.

Hedonic equation for Ku-ring-gai LGA

The Ku-ring-gai hedonic equation included 712 observations. That is, there were 712 sales during the financial year 2004-05 for which sufficient detail was available. Of these 712 houses, 17 were listed (2.4 per cent) as being of ‘local heritage significance’. The mean sale price for all houses sold during the sample period was $1.08 million. The mean block size was 1037 m^2. The mean number of bedrooms was 3.8 and the mean number of bathrooms was 2.6.

The mean sale price of the 17 heritage-listed properties was $1.7 million, around 58 per cent higher than the mean sale price for all properties sold. The mean land size for heritage-listed properties was 1173 m^2. The mean number of bedrooms was 3.9 and the mean number of bathrooms was 2.7.

As shown in table C.2, three hedonic price equations models were estimated, one with just structural variables, one with structural and locational variables, and one that distinguished between types of heritage properties. The R-squared of the structural-only model was 0.47. When the locational variables were added the explanatory power of this regression, as reflected by the R-squared, increased to 0.58. The R-squared was also 0.58 when heritage was separated into two variables. These results are consistent with other hedonic regressions (see, for example, Sirmans et al. 2005; Malpezzi et al. 1980).

The first regression included only structural independent variables. A pool, second storey, rumpus room, renovation and tennis court were all dummy variables with 1 indicating the variable was present and 0 if the variable was not. Bed 4, bed 5, and bed 6 were also dummy variables, indicating the additional value of the fourth, fifth and sixth bedrooms above a three bedroom house. The number of bathrooms was a linear variable indicating the exact number of bathrooms. The area of the block of land (per 100 m^2) was also included. No data were available on the size of the house, other than the number of bedrooms and bathrooms. It appears likely that the estimates of the bedroom and bathroom variables are also partly proxies for the size of the house.

All these structural variables were significant at the 1 per cent level. The sixth bedroom (31 per cent) and renovation (27 per cent) provided the largest percentage increase in value. Importantly, the coefficient and significance level of most of the structural variables remained fairly stable when locational variables were added to the model. This indicates that the observed structural variables were not accounting for locational effects.

Heritage was represented by a dummy variable (taking the value of 1 when heritage listed and 0 if not). The hedonic model estimates indicate that the heritage variable captured a strong location effect. Without accounting for location (i.e., regression without Postcode variables), heritage listing added 27 per cent to the value of a house (significant at the 1 per cent level). After including locational variables, the added value of heritage was reduced to 14 per cent (significant at the 5 per cent level). The addition of location variables did not effect the coefficient of other structural variables anywhere near as much, nor did it effect their significance (all were significant at the 1 per cent level before and after the addition of locational variables). This implies that, while there is a correlation between increased house value and heritage listing, caution should be exercised in ascribing causation. For example, the model indicates that the heritage-listed Ku-ring-gai properties sold in 2004-05 occurred in the more affluent, and desirable, suburbs to live — the most 'pricey' suburbs Killara, Roseville and Gordon, which comprise only 25 per cent of houses sold, represented 71 per cent of heritage-listed properties sold. That is, care

should be exercised in extrapolating the effect of heritage listing beyond those suburbs to say St Ives (Postcode 2075).

Table C.2 **Ku-ring-gai hedonic price equations**

Variable	*Coefficient without location variables*	*Percent effect on price*	*Coefficient with locational variables*	*Percent effect on price*	*Coefficient with different heritage*	*Percent effect on price*
R-squared	0.47	..	0.58	..	0.58	..
Constant	6.416**	..	6.400**	..	6.399**	..
Pool	0.086**	9.0	0.100**	10.5	0.099**	10.4
Second storey	0.089**	9.3	0.059**	6.1	0.059**	6.1
Rumpus	0.051**	5.2	0.052**	5.3	0.052**	5.3
Renovate	0.241**	27.3	0.203**	22.5	0.204**	22.6
Tennis Court	0.121**	12.9	0.112**	11.9	0.108**	11.4
Area ($100m^2$)	0.022**	2.2	0.026**	2.6	0.026**	2.6
Heritage	**0.242****	**27.4**	**0.133***	**14.2**	**..**	**..**
Heritage large	**..**	**..**	**..**	**..**	**0.190****	**20.9**
Heritage normal	**..**	**..**	**..**	**..**	**0.059**	**6.1**
Bed 4	0.071**	7.4	0.094**	9.9	0.093**	9.7
Bed 5	0.149**	16.1	0.149**	16.1	0.149**	16.1
Bed 6	0.273**	31.4	0.255**	29.0	0.251**	28.5
No. of bathrooms	0.020**	2.0	0.029**	2.9	0.029**	2.9
PO 2069	..	..	0.163**	17.7	0.165**	17.9
PO 2070	..	..	0.088*	9.2	0.094*	9.9
PO 2071	..	..	0.163**	17.7	0.165**	17.9
PO 2073	..	..	-0.049	-4.8	-0.044	-4.3
PO 2074	..	..	-0.109**	-10.3	-0.105**	-10.0
PO 2075	..	..	-0.172**	-15.8	-0.168**	-15.5
PO 2076	..	..	-0.130**	-12.2	-0.124**	-11.7

** Significant at the 1 per cent level. * Significant at the 5 per cent level. **PO** Postcode.

Sources: RP Data Ltd, Commission estimates.

Distinguishing between heritage places

In addition to the strong locational bias of the heritage variable, there also appeared to be two distinct types of heritage-listed properties. First, many heritage-listed places (especially in the more affluent suburbs) were unique large buildings, with significantly above-average structural attributes. Other heritage-listed places had attributes which were more consistent with the average house in the Ku-ring-gai LGA. In order to investigate whether the 'type' of place listed mattered, heritage was split into large heritage and average heritage places. The hypothesis was that

heritage listing has different effects on properties depending on the pressures faced by each type of property. An average heritage house would face the normal development pressures that typical non-heritage houses face. Large iconic heritage places do not face these pressures as buyers typically do not generally purchase these properties with the intention to re-develop the land.

Of the 17 heritage places sold in Ku-ring-gai during 2004-05, 10 were assessed as being large heritage properties and seven were assessed as 'average' heritage places. The mean block size of large heritage properties was 1333 m^2, compared with a mean block size of 944 m^2 for an average heritage property. 'Large' heritage places also have double the mean number of bathrooms of 'average' heritage places. The mean number of bedrooms was 4.7 for 'large' heritage places compared with 2.9 for average heritage places. The mean sale price of 'large' heritage places was $2.1 million, compared with $1.1 million for 'average' heritage places. There is also a locational bias for 'large' heritage places, with eight of the 10 being located in Killara and Gordon. 'Average' heritage places were more evenly spread around the Ku-ring-gai LGA, with Roseville, Lindfield, Killara, Pymble and Wahroonga all containing such places.

Distinguishing between heritage places significantly affects the coefficient of the heritage variable. Other structural and locational variables remain stable when heritage was split. 'Large' heritage places command a 21 per cent price premium (significant at the 1 per cent level), which is above the 14 per cent premium estimated when heritage is combined. However, for places that have the characteristics of an 'average' house in Ku-ring-gai, heritage listing has, a coefficient of 0.06 and standard error of 0.09 — indicating no significant effect in explaining the value of property. Therefore, the null hypothesis that heritage-listing does not affect the value of an 'average' house cannot be rejected.

Do housing attributes affect the probability of heritage listing?

The hedonic price models estimated the significance of structural and locational variables in determining the sale price of properties in the Ku-ring-gai LGA.

A logit model is an additional model which can assist in analysing the extent to which the value of a property is influenced by heritage listing. This model estimates the percentage change in the probability of heritage listing that results from the presence of the independent variables. The logit model was estimated using the same information as used for estimating the hedonic model and the results are reported in table C.3.

The logit model results support the more detailed interpretation that heritage listing is dependent on location and on whether the house and land size are large. The model estimates that a two storey house with tennis court has almost a 300 per cent greater probability of heritage listing in Ku-ring-gai than a single storey house with no tennis court. Further, houses in Pymble, Turramurra and Wahroonga have around a 90 per cent *lower* probability of being heritage listed than the base suburb of Gordon. This supports the estimates from the hedonic equation (table C.2) that 'large' heritage places command a price premium, while heritage listing of 'average' houses has no significant price effect.

Table C.3 **Ku-ring-gai LGA logit model**
Significant variables

Variable	*Coefficient*	*% change in the probability of listing for an increase in the variable*
Constant	-4.01**	-98.2
Second storey	1.24*	245.6
Tennis Court	1.34*	281.9
PO 2073	-2.21+	-89.0
PO 2074	-2.39*	-90.8
PO 2076	-2.13+	-88.1

** significant at the 1 per cent level. * significant at the 5 per cent level. + significant at the 10 per cent level. **PO** Postcode.

Sources: RP Data Ltd, Commission estimates.

C.4 Interpreting the results

Hedonic pricing models are location-specific and generalisations across geographical locations are fraught with difficulty. However, useful comparison can be made between areas when hedonic models identify those characteristics that are 'consistently valued (either positively or negatively) by homebuyers' (Sirmans et al. 2005, p. 4).

Both the Parramatta and Ku-ring-gai LGA hedonic price models demonstrate that generally, heritage listing does not have a significant effect (positive or negative) on the value of housing, when structural and locational attributes are taken into account. However, for 'large' unique houses in the Ku-ring-gai LGA there does appear to be a price premium for heritage listing. Importantly, the two regressions for Ku-ring-gai demonstrate the danger in extrapolating the price effect of heritage listing on large houses to average houses. That is, it is not correct to argue that heritage listing will increase values of average houses because 'large' heritage properties receive a premium.

Care should also be taken when interpreting hedonic modelling results to argue that heritage does not have a negative effect on an individual property. In addition to the general nature of hedonic modelling (i.e., it calculates the average price effect), it may not capture the full extent of any reduction in value because it is based on actual sales during the sample period (financial year 2004-05). That is, depressed land value may cause the owner to delay selling the property, resulting in such depressed prices not being included in the sample period of the hedonic model.

The two estimated hedonic models support the argument that the value of heritage listing is, like all real estate, highly susceptible to location attributes. This may reflect the fact that heritage listed properties occur mainly within the more highly priced suburbs of LGAs. Thus, the vast majority of the higher price of these properties comes from their location rather than listing — this is consistent with the old real estate adage: 'location, location, location'.