Does the housing market value heritage? Some empirical evidence.

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Abstract

This paper discusses an empirical study conducted in Sydney’s upper north shore with the primary aim of estimating the market price differential between heritage-listed and regular, unlisted houses using the hedonic price technique. The research also examined the relationship between market price and the level of heritage significance of heritage houses. After controlling for main property attributes, heritage-listed houses were found to enjoy a premium over unlisted houses. This premium is a measure of the combined value placed by the market on both, the heritage character of houses and their statutory listing status. The level of heritage significance was also found to have a positive influence on price.

JEL Classification: R21, R52, Z19

Key words: conservation areas, designation, hedonic price, heritage, heritage significance, housing attributes, listing, price differential, Sydney.

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1. Introduction

The past twenty years have seen a significant increase in effort to conserve buildings of cultural and heritage significance in N.S.W. The built heritage of N.S.W. includes a large number of privately owned residences. Society relies on home owners to preserve these houses for the enjoyment of present and future generations. Changing consumer tastes and land development opportunities are gradually eroding the urban stock of heritage houses\(^1\). Community groups, historical societies, the National Trust, and the state and local governments are trying to contain this erosion by promoting conservation through efforts like identifying potential heritage, raising community awareness about heritage, and offering heritage advisory services to home owners. A more potent initiative to prevent demolition of heritage houses has come from the government in the form of regulation. Heritage houses are afforded legal protection by ‘listing’ them in the statutory Local Environment Plans (LEPs); proposed renovations or demolitions to listed houses require local government approval. Use of statutory heritage-listing has gained momentum in N.S.W. since a Ministerial Direction was issued in 1985 requiring local councils to provide for conservation of heritage items in their LEPs (NSW Heritage Office 2000). Heritage home owners and policy planners are often faced with the question of how statutory heritage-listing impacts on the marketability of heritage houses. While listing protects heritage items from permanent loss, it does not induce owners to undertake preservation or restoration of their property in excess of the required basic, minimum level of maintenance. A market that favours heritage-listed houses may encourage owners to

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\(^1\) Hughes (ed.) (1999) catalogues some of the demolished heritage houses of Sydney.
carry out conservation work over and above the required level. Such a market may also reduce owners’ resistance to heritage-listing. Conversely a market that discriminates against heritage-listed properties may dampen discretionary investment in conservation work by owners. This could lead to a gradual deterioration of the heritage fabric.

There is limited research on how heritage-listed houses perform in the market with respect to market prices. Existing studies are qualitative or anecdotal in nature. This paper discusses a quantitative, empirical study conducted in Sydney’s upper north shore with the primary aim of estimating the market price differential between heritage-listed and regular, unlisted houses after controlling for main property attributes. This price differential is a measure of the extent to which the costs of owning a heritage-listed house are outweighed by the benefits of owning them. While the benefits of owning heritage tend to be intangible in nature and flow from the pleasure or enjoyment associated with owning a historic or unique house, the costs are more visible. These include the cost of maintaining heritage features of the property and ensuring alterations and extensions to the house are sympathetic to them. Costs also include the opportunity cost of forgoing land development opportunities which are available to unlisted houses. The net impact of these benefits and costs is the subject of investigation of the study reported here.

A secondary aim of the research was to examine the relationship between the heritage significance of a house and its market price. While local council statutory listings do not explicitly grade listed houses by their heritage values, there is a wide variation in the level of historic or cultural values heritage houses denote. A historic house associated with the life of a famous Australian person may enjoy a heritage value that is higher or lower compared to a historic house valued for its distinctive architectural design. Similarly, a
A historic house with most of its original features intact is likely to represent a higher heritage value than a house which has lost some of its original features but is otherwise in outstanding condition. Here again little is known about the housing market and whether it differentiates among houses of varying heritage significance. The study described here tried to ascertain if the heritage value of listed houses - as rated on an ordinal scale - has any impact on their market price.

Section 2 of this paper summarises findings from existing research on the link between house prices and heritage-listing. Section 3 describes the methodology used in this research, the market for which data were collected, and summary statistics for the housing attributes used in analysis. It also highlights sample constraints faced when studying heritage-listed houses. Their low incidence in the overall housing market can pose a challenge for quantitative cross-section studies. Section 4 discusses the empirical analysis involved in estimating the property price differential. Section 5 presents the empirical evidence on the link between property prices and the level of heritage significance. Section 6 states the conclusions and discusses the applicability of findings from this study to other markets.

2. Review of existing empirical evidence

Two broad approaches have been used by researchers to examine the relationship between price and heritage-listing². One of these, the hedonic price approach, models house price as a function of housing and location characteristics. Architectural features and the heritage status are included as explanatory variables in the model. The hedonic approach is based on the tenet that “… goods are valued for their utility bearing attributes or

² The terms ‘heritage-listing’, ‘listing’ and ‘designation’ are used interchangeably in this paper.
characteristics’’ (Rosen, 1974). And the value or implicit price of each characteristic is estimated by regressing the house price on these characteristics. A second approach examines property price movements in the period before and after statutory heritage-listing is introduced or compares price movements of listed houses with trends in the overall housing market. Differences in housing attributes are usually controlled for by using houses with identical size, location and internal layout.

Shipley (2000) examined the sale price history of 208 heritage houses in Ontario, Canada. Each designated property’s sale price was tracked for the period 1976-1997 and the price movement was compared to the average house price for the comparable area. Shipley found that for 74% of the listed or designated houses, the sale price increase in this period was at par or better than the average sale price. The rate of sale among designated houses was also found to be at par or better than the prevailing market rate. However a limiting feature of this study is that it did not control for differences in house and location attributes. In Shipley’s words, “…this study dealt with only one of the many issues affecting property values”. Therefore observed differences in price appreciation cannot be clearly attributed to differences in the heritage status of houses. Countrywide Valuers (1992) and D’Arcy (1991) examined the effect of heritage controls on property values in the state of Victoria. Both studies concluded that the controls did not have an adverse impact on property values. Again these findings have limited application given that these studies did not control for differences in property attributes.

Other empirical work has focused on heritage conservation areas. Conservation areas include a collection of houses, streetscapes, subdivision patterns etc. which are collectively valued; individual elements in this group may or may not have heritage value
but together they represent something that distinguishes them from their surroundings; they have a collective worth that justifies their preservation as a whole\(^3\). All development within this area is subject to controls such that additions and alterations are sympathetic to the central heritage character. Most empirical work examining the price impact of listing of conservation areas has found houses within listed areas enjoy a price premium over houses outside the area. Penfold (1994) studied the impact of heritage controls on prices in four conservation areas in Sydney located in Ashfield, North Sydney, Waverly and Burwood councils respectively. This study is reviewed in more detail given its relevance to Australia. Heritage controls for these conservation areas came into effect between 1982 and 1989. For each conservation area, Penfold identified a control area that had similar subdivision layouts, architecture, density, topography and views but was not heritage-listed. The average sale price was compared in the three year period prior to designation to the three year period after designation in each zone. Average sales price figures were based on sales of about 11 to 38 houses in each area. Designation appears to have had a favourable impact on prices in the two conservation zones of Burwood and Ashfield. However in case of the remaining two conservation zones, designation seems to have made little difference to price movements.

The remaining studies reviewed here use the hedonic price approach. Ford (1989) examined the effects of designation and regulation of local historic districts on house prices. Houses in designated and non-designated districts in Baltimore, Maryland, U.S. were used to develop a hedonic price model. Based on a sample of 461 houses the study found that prices of houses in historic districts before designation came into effect, were

\(^3\) This description of conservation areas draws on definitions by N.S.W. Heritage Office and Department of Urban Affairs and Planning (1996).
not significantly higher than those outside the historic district. However after designation became statutory, Ford found that houses in designated districts had significantly higher prices compared to those in non-designated ones.

Asabere et al. (1989) conducted a hedonic price study of 520 houses sold between 1983 and 1985 in the New England city of Newburyport, Massachusetts, U.S. Their study found that prices of houses located inside a historic zone were not significantly different from those located outside the zone. They also found that architectural styles like ‘Colonial’, ‘Victorian’, ‘Federal’ and ‘Garrison’ styles enjoyed a significant premium over the reference category style i.e. ‘ranches’.

Scaffer and Millerick (1991) examined the impact of designation of the Ridge Historic District, Chicago, U.S. This historic district encloses two smaller areas further designated as “Chicago Historic Districts” in recognition of specific architectural styles they represented. While designation was found to be beneficial to houses in the larger Ridge Historic District, it had a negative impact on houses in the two smaller Chicago Historic Districts.

To conclude, existing evidence suggests that the market places a premium on houses that form part of designated heritage precincts. However it is still unclear how the market behaves when a minority of individually heritage-listed houses stand dispersed among non-heritage, regular houses. The study described here attempts to fill this information gap.
3. Methodology & data

As explained in section one, the primary aim of this study is to ascertain the house price differential between heritage-listed houses and unlisted ones. Introduction of statutory listing and development controls often causes uncertainty in the market. Owners and buyers are unsure of the restrictiveness of controls and the impact they may have on the value of their property. However, with time as the uncertainty resolves the market reaches a new equilibrium. The focus of this study is the price differential in a market that has had time to regain stability.

To identify the price differential attributable solely to the heritage and listing status of a house, influence of other determinants like house size, quality and location had to be removed. This was done through the hedonic price method by regressing house prices to main house characteristics. Housing data for the Ku-ring-gai region of Sydney was used. This region has a large number of heritage houses. A short description of this region, its people and its history is presented before discussing data and analysis issues. This background helps place the data and the results in perspective.

3.1 Ku-ring-gai - a profile

Located approximately 15 kilometres north-west of the Sydney central business district (see Figure 1), Ku-ring-gai spans an area of about 85 square kilometres. It gets its name from the aboriginal tribal group ‘Guringai’ that once roamed this area. The land here forms a ridge and the railway and major road route run along the ridge line. Known for its

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4 Historical details of Ku-ring-gai reported here are drawn from Matthews (1978). Figures on dwellings, and socio-economic and demographic characteristics were sourced from Ku-ring-gai Council (2002).
green landscape and tree cover, 40% of its area is covered by open space. The remaining land is used predominantly for residential purposes leaving less than 1% for business uses. The suburbs of Ku-ring-gai are characterised by single dwellings with large lot sizes averaging at about 1,100sq.m. Landscape features and gardens form an integral part of houses here. The residential strategy has continued to emphasise low density housing with separate houses forming 86% of its 35,500 dwellings. The majority of dwellings (i.e. 83%) are owner-occupied.

Ku-ring-gai has a population of over 101,000. 87% of the people here live in families. Compared to the average for Sydney, it has a significantly higher proportion of people who are married. The large number of non-government schools in Ku-ring-gai draws families with primary and high school age children to the area. Socio-economic indicators like income, education and occupation show that the people of Ku-ring-gai enjoy a greater degree of affluence than the average Sydney population. A comparison of the ethnic compositions of Ku-ring-gai and Sydney shows that a much higher proportion of the former cite “English” as their ancestry.

The earliest settlers came to Ku-ring-gai at the beginning of the nineteenth century. Soon thereafter Ku-ring-gai became an important source of timber in Sydney with timber-getting operations reaching their peak in 1820s. Hand in hand with timber-getting went the rough life of saw pit convicts and labourers and excessive drinking. The earliest houses in the region were slab and bark huts with dirt floors. Robert Pymble, who arrived in the colony in 1821, is credited with introducing fruit trees to the region. Fruit trees were planted on the land depleted of its forests. With the decline of timber-getting and emergence of orchards in Ku-ring-gai came a more stable community. By late 19th century
Ku-ring-gai was gradually transformed into a strong residential society. Residential development was given further impetus by the introduction of the railway in the late 1880s. Land grants to original settlers were progressively subdivided and houses proliferated on either side of the railway.

Ku-ring-gai has a collection of fine houses with some designed by Australia’s leading architects. These include houses designed at the turn of the century by Sir John Sulman, Howard Joseland and Walter Liberty Vernon and those made in later years by Harry Seidler, Neville Gruzman, and Bruce Rickard. In 1986 the Ku-ring-gai Council commissioned a study to identify heritage buildings in the area. In 1989 the Council initiated a Local Environment Plan (LEP) to protect buildings identified as having heritage values. Over 700 items are now listed as heritage items in the council’s plans. They include some non-residential buildings like schools, churches, and shops, and a large number of private residences. While most of these listed houses belong to the Federation and interwar periods, some houses designed in the latter half of the 20th century are also listed. Some of the heritage houses are grand mansions depicting the affluence of their owners while others are more modest cottages built for workers. The National Trust of Australia has identified conservation areas in Ku-ring-gai (National Trust of Australia, NSW, 1996). These areas are characterised by a large collection of interwar houses in a remarkable state of intactness. The conservation areas do not have statutory recognition but are presently being evaluated by the Ku-ring-gai Council for their heritage significance.

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3.2 Sample design & data

This section discusses how the sample for this study was drawn. The first step in sampling was identifying a reasonably homogenous property market with a relatively uniform underlying preference structure. Care was taken to minimise the possibility of market segmentation. A segmented market would require estimating a separate hedonic price model for each segment and given the limited sample this would have reduced the reliability of parameter estimates. Market preferences are determined by consumer tastes and latter in turn are governed – though not entirely – by people’s income, education and occupation profiles, ethnicity, family structures and stage of life. By selecting suburbs with similar demographic, ethnic and socio-economic profiles, the likelihood of

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**Figure 1: Sydney**

**Figure 2: Ku-ring-gai Council area**

Note - area bounded by double lines indicates the eight suburbs sampled for the study; the dotted line denotes the railway.
identifying a homogenous market would be maximised. Therefore a comparative analysis of community profiles within Ku-ring-gai was conducted using 2001 Census data (Australian Bureau of Statistics, 2001). Property agents in the area were also asked for their opinion on which suburbs could be aggregated and analysed as a single market. Consequently eight suburbs\(^6\) were used to define the sampling frame (see Figure 2). These suburbs form a geographically contiguous area and the main transport corridor runs through each of them. Flats and units in these areas were excluded from the sampling frame since heritage houses are almost entirely separate houses. The sample was drawn from the Ku-ring-gai Council sales register. This register lists each property whose title is transferred, the corresponding transfer price, and the transfer date\(^7\).

There were 2763 sales of separate houses in 1999-2000 and 2.6 % of these, i.e. 73 houses, were heritage-listed. This is consistent with the 2% incidence of listed houses in the total housing stock in Ku-ring-gai. Table 1 shows the breakdown of sales across these two categories. The total sample size for this study was governed by the number of heritage house sales. All 73 sales in the heritage-listed category were selected for the study. Given that the primary objective was to estimate the price differential attributable to the heritage-listing status, a similar number of unlisted houses were randomly drawn from the group of unlisted houses. The price variability in the listed group was found to be much higher than that for the unlisted group (standard deviations for price are reported in the next section). Given that reliability of parameter estimates is driven by variability in both the groups,\(^6\)

\(^{6}\) The suburbs included were - Wahroonga, Warrawee, Turramurra, Pymble, Gordon, Killara, Lindfield, & Roseville.

\(^{7}\) While the majority of transfers represent sale transactions, some of them may represent non-market transfers like transfers of deceased estates or transfers to partners or siblings within families.
increasing only the number of unlisted houses would have increased data collection costs without significantly improving reliability.\footnote{The possibility of increasing the heritage-listed sample by including house sales in 2001 was considered. However 2001 sales data were not included on account of the high volatility in prices in that year and the structural instability this may have introduced.}

<table>
<thead>
<tr>
<th></th>
<th>All houses</th>
<th>Heritage-listed houses</th>
<th>Unlisted houses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2000 sales</td>
<td>2763</td>
<td>73</td>
<td>2690</td>
</tr>
<tr>
<td>Sample selected</td>
<td>159</td>
<td>73</td>
<td>86</td>
</tr>
<tr>
<td>Sample achieved</td>
<td>140</td>
<td>64</td>
<td>76</td>
</tr>
</tbody>
</table>

Data were collected for housing attributes typically included in hedonic house price studies.\footnote{See Freeman (1979) for examples of housing attributes used as explanatory variables in empirical studies.} Past empirical studies have shown that house prices tend to be driven by attributes that can be broadly grouped as structural attributes (e.g. house size, layout, quality of construction), location attributes (e.g. proximity to amenities, aspect), neighbourhood attributes (e.g. ethnic, demographic and socio-economic profiles) and environmental attributes (e.g. levels of air and noise pollution). An attempt was made to collect data for most of these with the exception of neighbourhood attributes. The latter were considered redundant for this study given that houses were sampled from a region with homogeneous neighbourhood characteristics. Data were collected from multiple sources. Council records, property sales ads, and records of Ku-ring-gai Historical Society were used; in some cases information was also received from home owners. Data were collected for all key attributes. However some house characteristics (e.g. number of bathrooms, number of carports or garages) had to be excluded due to non-availability of
data. Houses with missing data were also excluded\textsuperscript{10}. In the end data for 64 listed houses and 76 unlisted were collected for the following attributes; (corresponding variable names, as they appear in regression outputs later, are indicated in parenthesis):

1. **Land size**: the total land area of the property expressed in hundreds of square meters; (AREA\_00M).

2. **Number of rooms**: this served as a proxy for built-up area; the total number of rooms included bedrooms, lounge room, dining room, family room, study, sunroom etc. but excluded bathrooms, kitchen and laundry; (TOTROOMS).

3. **Quality of house interior**: the internal condition of the house was classified as ‘excellent’, ‘average’, ‘poor’. Where possible owners were requested to do this classification. In other instances information from property advertisements was used to classify the houses eg. properties described as ‘needs tender loving care’ or ‘renovater’s delight’ were coded as ‘poor’ and those described as ‘newly renovated’, ‘superb interiors’ were coded as ‘excellent’. Two binary variables were used to code the condition; (EXCELLENT\_INT\_COND & POOR\_INT\_CONDITION).

4. **Estimated age** of house in years; (AGE).

5. **Street access**: some houses are built on battleaxe shaped land; such houses do not have street frontage but are connected to the street with a long driveway referred to as the ‘leg’ of the battleaxe; such houses are coded as ‘1’ using a binary variable; (BATTLEAXE)

6. **Swimming pool**: houses with pools are coded as ‘1’ using a binary variable; (SWIMPOOL).

\textsuperscript{10}No data could be found for 9 listed and 10 unlisted houses. It is possible that some of these properties were not sold in the market and their ownership was transferred by private arrangements.
7. **East or west of the railway**: the ‘east’ side of the ridge offers better topography than the ‘west’. This location attribute is considered a key driver of house prices in Ku-ring-gai and was coded as ‘1’ using a binary variable; (EAST).

8. **Proximity to train station**: whether a property is within walking distance of a station is an important criteria in the property purchase decision; the distance ‘as the crow flies’ from the house to the nearest train station in kilometres was estimated; (KMS_TO_STATION).

9. **Proximity to business district**: the distance, in kilometres, ‘as the crow flies’ between a property and the closest business district i.e. Chatswood was estimated. This variable also served as a proxy for the distance to Sydney CBD; Chatswood is located about 8 km north of the CBD (see Figure 1); (KMS_TO_CHATSWOOD).

10. **Traffic levels on street**: the average weekday traffic levels (measured in 000s of vehicles) on the street on which the property is located is used. This attribute captures effects like road safety, noise pollution and air pollution; (TRAFFIC000S).

11. **Whether or not heritage-listed**: listed houses are coded as ‘1’ using a binary variable; (HERLISTED).

12. **Time of sale**: to control for inflation in the property market in the two-year period this time variable was included; it was coded over the 24 month period with January 1999 coded as ‘1’ and December 2000 coded as ‘24’; (MONTH24).

11 Traffic counts for most streets were obtained from Ku-ring-gai Municipal Council records. Counts for some major roads were sourced from Roads & Traffic Authority (1999).

12 Home loan bank interest rates (both three-year-fixed, and variable) in this period were found to increase linearly with the ‘time of sale’. The correlation coefficient for ‘time of sale’ and variable interest rate was 0.96 and that for ‘time of sale’ and three-year-fixed interest rate was 0.76. Given that interest rates effects would be accounted for by the ‘time of sale’ variable, a separate interest rate variable was not included in the analysis.
13. **Heritage significance level of a listed property**: a 10-point ordinal scale was used to indicate the level of heritage significance of listed houses. Architectural, aesthetic and social factors were considered in assessing the heritage significance. A score of ‘10’ represented ‘high heritage significance’ and a score of ‘1’ represented ‘low heritage significance’. The significance rating was done on request for this study by the Heritage Conservation Planner at Ku-ring-gai Council. (HERSIGNIFICANCE)

Attributes reflecting the architectural style of houses were considered for inclusion. In the initial stages of data collection an attempt was made to capture the style through qualitative variables. However the vast diversity of house styles and features in Ku-ring-gai rendered this task too complex to allow meaningful classification. Therefore no architectural-style related attributes could be included in this study. As a result, the binary ‘heritage-listed’ variable captures the influence of both, the heritage characteristics, and the listing status of houses.

### 3.3 Sample profile

A descriptive profile of the houses used in the study is summarised in Table 2. Heritage-listed houses are compared with unlisted houses on all attributes used in the study.

The average price for listed houses was $1.2 million compared to $0.8 million for unlisted ones. The spread in prices is also larger for heritage houses. While the cheapest property in both groups was priced at about $0.35 million, the most expensive heritage-listed property sold for $3.8 million in contrast to $1.9 for an unlisted one. A difference in property areas perhaps explains this price disparity to some extent. Heritage houses had an average lot
area of 1560 square metres compared to 1150 for unlisted ones. Again, the heritage sample has a much higher variability in area (std. dev. = 695 sq.m.) compared to the unlisted sample (std. dev. = 469 sq.m.).

| Table 2: Summary statistics (sample - 64 heritage-listed houses, 76 unlisted houses) |
|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
|                                             | Listed                                      | Unlisted                                     | Listed                                      | Unlisted                                     |
| **Sale price ($)**                         | Mean 1,246,948                              | 813,960                                      | Median 1,026,500                             | 735,000                                      | Maximum 3,800,000                             | 1,850,000                                    |
|                                             |                                              |                                              | Minimum 360,000                              | 344,000                                      | St. Dev. 739,199                              | 352,873                                      |
| **Property area (sq. m.)**                 | Listed 1562                                 | 1150                                         | Median 1402                                 | 987                                           | Maximum 3747                                 | 3717                                         |
|                                             |                                              |                                              | Minimum 500                                 | 496                                           | St. Dev. 695                                 | 469                                          |
| **Number of rooms**                        | Listed 9                                    | 8                                            | Median 9                                   | 8                                             | Maximum 14                                   | 13                                           |
|                                             |                                              |                                              | Minimum 3                                   | 4                                             | St. Dev. 2                                   | 2                                            |
| **Distance to station (km)**               | Listed 0.7                                  | 1.1                                          | Median 0.7                                 | 1.0                                           | Maximum 2.1                                 | 2.5                                          |
|                                             |                                              |                                              | Minimum 0.1                                 | 0.2                                           | St. Dev. 0.4                                 | 0.5                                          |
| **Distance to Chatswood (km)**             | Listed 6.7                                  | 6.8                                          | Median 6.5                                 | 6.9                                           | Maximum 11.5                                | 11.4                                         |
|                                             |                                              |                                              | Minimum 1.4                                 | 1.4                                           | St. Dev. 2.9                                 | 3.1                                          |
| **Traffic level (vehicles /day)**          | Listed 5,482                                | 3,473                                        | Median 1,648                               | 1,222                                         | Maximum 63,000                               | 64,618                                       |
|                                             |                                              |                                              | Minimum 100                                 | 100                                           | St. Dev. 11,410                              | 8,811                                        |
| **Estimated age (years)**                  | Listed 85                                   | 46                                           | Median 90                                  | 45                                            | Maximum 133                                 | 100                                          |
|                                             |                                              |                                              | Minimum 3                                   | 3                                             | St. Dev. 18                                  | 27                                           |

On the attribute of ‘internal quality’, the unlisted group has a slightly higher proportion of houses in the ‘excellent’ category and a lower proportion in the ‘poor’ category (see Figure 3). A comparison of number of houses with swimming pools shows that a higher proportion of heritage-listed houses have a pool (see Figure 4).
When it comes to location, the incidence of battle-axe houses was very low in both groups (see Figure 5). A comparison of the east-west distribution of houses (Figure 6) shows a higher proportion of heritage houses are located on the east side of the railway. This is consistent with the fact that early residential development favoured the east side given the better topography compared to the west.

Heritage houses also tend to be located close to railway stations. The streets on which older houses are built are more established through roads with slightly higher traffic.
levels. A small number of houses in both listed and unlisted groups are located on the two main roads (providing north-south and east-west routes respectively) with average weekday daily traffic of over 60,000 vehicles. However, the majority of houses are located on inner streets where traffic ranges from 1000 to 2000 vehicles per day.

The mean age of heritage-listed houses is 85 years with the oldest house in the sample dating back to about 1872. The youngest heritage house has an estimated age of about 30 years. Unlisted houses have a mean age of 46 years; the oldest of these was constructed about 100 years ago and the youngest about 3 years ago. To get an insight on the architectural profile of these houses, they were grouped into the following five key periods in Australian architecture\(^\text{13}\):

* Victorian period (1840-1890),
* Federation period (1890-1915)
* Interwar period (1915-1940),
* Post-war period (1940-60), and
* Late 20\(^{th}\) century (constructed after 1960).

Figure 7 and Figure 8 depict the distribution of houses in the listed and unlisted groups by these architectural periods. Listed houses are concentrated in the Federation and Interwar periods and the unlisted group has a higher proportion of more recently built houses.

\(^{13}\) This grouping into five architectural periods uses the classification presented in Apperly et.al. (1989).
4. Estimating the price differential - empirical analysis & findings

4.1 Model Fitting

Economic theory does not prescribe a functional form for hedonic price functions. Various statistical criteria including a measure of goodness-of-fit have to be relied on in selecting an appropriate functional form. In the first instance a linear function was used to regress untransformed house prices, \( P \), on housing attributes \( H, A_1, A_2, \ldots A_n \). Here ‘H’ represents the key variable of interest i.e. the dummy variable for whether or not a house is heritage-listed. The other attributes are those listed in section 3. (The only attribute withheld from the analysis was the one representing the heritage significance of listed houses; this attribute is used in the model described in section 5.)

\[
P = c + \beta_h H + \beta_1 A_1 + \beta_2 A_2 + \ldots + \beta_n A_n \quad \text{(Eq.1)}
\]

The OLS (Ordinary Least Squares) method was used. The fitted model had an adjusted \( r \)-square of 69%. However the error distribution was skewed and violated the normality
assumption. This prompted the search for an appropriate transformation. The price variable had a large spread for the chosen sample (a ratio of 1:10 for the lowest to highest price) suggesting that equal intervals of price difference have unequal significance over the spectrum of prices. A logarithmic function, providing equal significance to proportionate intervals, was therefore expected to provide a better fit than a linear function. The Box-Cox method was used to confirm if a logarithmic transformation of price would indeed be suitable.

The dependent variable ‘\( P \)’ was transformed using the formula\(^{14} \):

\[
P^{(\lambda)} = \frac{P^{\lambda} - 1}{\lambda P^{\lambda - 1}} \quad \text{when } \lambda \neq 0 \quad \text{(Eq.2)}
\]

\[
P^{(\lambda)} = p \ln P \quad \text{when } \lambda = 0 \quad \text{(Eq.3)}
\]

Here ‘\( p \)’ represents the geometric mean of ‘\( P \)’\(^{15} \). A value of \( \lambda = 0 \) is equivalent to using a logarithmic transformation. And a value of \( \lambda = 1 \) implies linear transformation. Alternate values of lambda between +1 and -1 were used to generate a series of price transformations. Each transformed price variable was used for regression. The weighted residual sum of squares (RSS) from these regression runs were plotted against the corresponding values of lambda (see Figure 9). The RSS for a linear function i.e. \( \lambda = 1 \) was much higher than the RSS for a logarithmic transformation i.e. \( \lambda = 0 \). The RSS is minimal in the region \(-0.6 < ? < 0.1\) with and confirms a log transformation is most appropriate.

\(^{14}\) The Box-Cox transformations were performed using the method described in Montgomery (2001).

\(^{15}\) The geometric mean was computed as follows: \( p = \text{anti} \log \left[ \frac{1}{n} \sum \ln P \right] \)
Regression with log of price resulted in a normal distribution of errors. Specification and diagnostic tests were then performed to check for violations of CLRM assumptions. The tests used and their results are reported below.

**Homoscedasticity**: White’s test was used to check if the assumption of homoscedasticity was met by the residuals. White’s test statistic \((d.o.f. = 20)\) had a value 33.98 with a \(p\)-value of 0.026. So residuals do not have constant variance. White’s heteroscedasticity-corrected variances and standard errors were used. These were found to be only marginally different from the OLS variances and standard errors, suggesting heteroscedasticity is not a serious issue with the data.

**Multi-collinearity**: pair-wise correlations among property attributes were examined. These were found to range from -0.47 to 0.55. The Variance-Inflating-Factor (VIF) for
each attribute was also computed and was found to be in the range of 1 to 2.2. There appears to be no evidence of multi-collinearity.

**Influence analysis**: The Mahalanobis distance was used to locate extreme values and the Cook’s distance was used to identify influential cases. Two observations were found to have high Mahalanobis distances (with values 46 and 37 respectively). However only one of these was found to have a significant influence on parameter estimation; its Cook’s distance value was 0.33. This observation was an unlisted house and was excluded from subsequent analysis.

**Autocorrelation**: Tests for autocorrelation found no evidence of correlation in the residuals. P-values associated with Ljung Box Q-statistics for first and higher order serial correlation were over 0.2.

**Structural stability**: Chow’s test was used to check if the coefficients of the hedonic price functions for heritage-listed and unlisted data were different. The $F_{(13,113)}$ statistic was 1.39, with a p-value of 0.17. This is not significant at 5% level of significance and confirms that the two functions have the same structure and that listed and unlisted data can be combined to estimate a single hedonic price function.

**Specification error**: Ramsey’s RESET test was conducted as a general test to check for specification errors. This returned an $F_{(2,124)}$ statistic of 0.84 with a p-value of 0.43. This value is not significant and hence the model appears to have been correctly specified.

The final model is presented in Table 3 below. Beta coefficients represent proportionate changes in price in response to unit changes in attributes. The model explains 78% of the variation in house prices. All coefficients possess expected signs – coefficients for area,
number of rooms, excellent internal condition, presence of swimming pool, and east side location are positive while those for poor internal quality, battle axe location, distance to station and city, and traffic levels, are negative.

### 4.2 Significance testing

There is no prior evidence or theoretical indication about the sign and magnitude of the price differential between heritage-listed and regular, unlisted houses. This study makes an initial hypothesis that the true market price differential attributable to the heritage-listing status is zero i.e. whether a property is heritage-listed or not makes no difference to the market price. The coefficient for the price differential $\beta_h$, (see Eq.1) is tested against this null hypothesis:

$$H_0: \beta_h = 0 \quad \text{and} \quad H_1: \beta_h \neq 0$$

The estimated value of $\beta_h$, the price differential is 0.11 and the t-statistic is 2.04. The probability of obtaining an absolute value of the t-statistic as high as this (if the true value of $\beta_h$ was indeed zero) is 0.04 or 4%. Therefore the null hypothesis is rejected at 5% level of significance. It can be concluded that on average, the prices of heritage-listed houses after controlling for other determinants, are 12% higher\(^{16}\) than those for unlisted ones. It is reiterated that this average price differential reflects the combined value of both, the heritage character, and the listing status of houses. The independent contributions of each of these components are not separable in this market given that most houses known to have heritage values have already been listed.

\(^{16}\) To interpret coefficients for dummy variables in semi-logarithmic equations, the antilog (to base e) of the coefficient is taken and ‘1’ is subtracted from it. For computational details refer to Gujarati (1995).
The 95% lower and upper confidence limits for $\beta_h$ are 0.5% and 25% indicating that in 95 out of 100 cases, intervals such as the ones computed here will contain the true value of $\beta_h$.

Table 3: Regression with dependent variable LOG(PRICE), 139 observations, White Heteroscedasticity-Consistent Standard Errors & Covariance

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>12.514</td>
<td>0.126</td>
<td>99.351</td>
<td>0.000</td>
</tr>
<tr>
<td>AREA_00M</td>
<td>0.031</td>
<td>0.005</td>
<td>5.909</td>
<td>0.000</td>
</tr>
<tr>
<td>TOTROOMS</td>
<td>0.099</td>
<td>0.013</td>
<td>7.885</td>
<td>0.000</td>
</tr>
<tr>
<td>EXCELLENT_INT_CONDITION</td>
<td>0.111</td>
<td>0.042</td>
<td>2.621</td>
<td>0.010</td>
</tr>
<tr>
<td>POOR_INT_CONDITION</td>
<td>-0.081</td>
<td>0.063</td>
<td>-1.279</td>
<td>0.203</td>
</tr>
<tr>
<td>AGE</td>
<td>-0.000</td>
<td>0.001</td>
<td>-0.199</td>
<td>0.843</td>
</tr>
<tr>
<td>BATTLEAXE</td>
<td>-0.025</td>
<td>0.128</td>
<td>-0.199</td>
<td>0.842</td>
</tr>
<tr>
<td>SWIMPOOL</td>
<td>0.048</td>
<td>0.045</td>
<td>1.060</td>
<td>0.291</td>
</tr>
<tr>
<td>EAST</td>
<td>0.214</td>
<td>0.042</td>
<td>5.099</td>
<td>0.000</td>
</tr>
<tr>
<td>KMS_TO_STATION</td>
<td>-0.159</td>
<td>0.046</td>
<td>-3.486</td>
<td>0.001</td>
</tr>
<tr>
<td>KMS_TO_CHATSWOOD</td>
<td>-0.023</td>
<td>0.008</td>
<td>-2.9195</td>
<td>0.004</td>
</tr>
<tr>
<td>TRAFFICO00S</td>
<td>-0.013</td>
<td>0.003</td>
<td>-4.559</td>
<td>0.000</td>
</tr>
<tr>
<td>HERLISTED</td>
<td><strong>0.112</strong></td>
<td><strong>0.055</strong></td>
<td><strong>2.044</strong></td>
<td><strong>0.043</strong></td>
</tr>
<tr>
<td>MONTH24</td>
<td>0.005</td>
<td>0.002</td>
<td>2.230</td>
<td>0.028</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.797</td>
<td>Mean dependent var</td>
<td>13.695</td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.776</td>
<td>S.D. dependent var</td>
<td>0.510</td>
<td></td>
</tr>
<tr>
<td>S.E. of regression</td>
<td>0.241</td>
<td>Akaike info criterion</td>
<td>0.088</td>
<td></td>
</tr>
<tr>
<td>Sum squared resid</td>
<td>7.262</td>
<td>Schwarz criterion</td>
<td>0.383</td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td>7.918</td>
<td>F-statistic</td>
<td>37.842</td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
<td>2.237</td>
<td>Prob(F-statistic)</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

5. The link between heritage significance and price - empirical analysis and findings

Heritage-listed houses in the sample were rated on their heritage significance.

Architectural, aesthetic and social factors were considered in assessing the heritage
significance. A ten-point ordinal rating scale was used. A rating of ‘10’ meant a house had high heritage significance and a rating of ‘1’ meant it had low significance rating. Houses could be given a rating of any whole number between 10 and 1. Figure 10 below shows the distribution of heritage houses in the sample across these rating points. It illustrates the fact that all heritage houses are not uniform in the heritage values they represent.

Using the sample of 64 heritage-listed houses, a regression model was fitted with the log of price as the dependant variable. Besides the attributes used in the previous model (section 4.1), the heritage significance rating, ‘HERSIGNIFICANCE’, was also included as an explanatory variable. Parameter estimates are given in Table 4 below. The estimated model explains 85% of the total variation in house prices.
Table 4: Regression with Dependent Variable LOG(PRICE), 64 observations, White Heteroscedasticity-Consistent Standard Errors & Covariance

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>12.602</td>
<td>0.176</td>
<td>71.745</td>
<td>0.000</td>
</tr>
<tr>
<td>AREA_00M</td>
<td>0.040</td>
<td>0.006</td>
<td>6.646</td>
<td>0.000</td>
</tr>
<tr>
<td>TOTROOMS</td>
<td>0.079</td>
<td>0.019</td>
<td>4.065</td>
<td>0.000</td>
</tr>
<tr>
<td>EXCELLENT_INT_CONDITION</td>
<td>0.048</td>
<td>0.063</td>
<td>0.765</td>
<td>0.448</td>
</tr>
<tr>
<td>POOR_INT_CONDITION</td>
<td>-0.109</td>
<td>0.084</td>
<td>-1.298</td>
<td>0.200</td>
</tr>
<tr>
<td>AGE</td>
<td>-0.000</td>
<td>0.001</td>
<td>-0.136</td>
<td>0.893</td>
</tr>
<tr>
<td>BATTLEAXE</td>
<td>-0.163</td>
<td>0.215</td>
<td>-0.760</td>
<td>0.451</td>
</tr>
<tr>
<td>SWIMPOOL</td>
<td>0.045</td>
<td>0.083</td>
<td>0.544</td>
<td>0.589</td>
</tr>
<tr>
<td>EAST</td>
<td>0.124</td>
<td>0.063</td>
<td>1.955</td>
<td>0.056</td>
</tr>
<tr>
<td>KMS_TO_STATION</td>
<td>-0.157</td>
<td>0.078</td>
<td>-2.018</td>
<td>0.049</td>
</tr>
<tr>
<td>KMS_TO_CHATSWOOD</td>
<td>-0.030</td>
<td>0.010</td>
<td>-2.985</td>
<td>0.004</td>
</tr>
<tr>
<td>TRAFFIC000S</td>
<td>-0.011</td>
<td>0.003</td>
<td>-4.168</td>
<td>0.000</td>
</tr>
<tr>
<td>MONTH24</td>
<td>0.003</td>
<td>0.003</td>
<td>0.732</td>
<td>0.467</td>
</tr>
<tr>
<td><strong>HERSIGNIFICANCE</strong></td>
<td><strong>0.047</strong></td>
<td><strong>0.013</strong></td>
<td><strong>3.471</strong></td>
<td><strong>0.001</strong></td>
</tr>
</tbody>
</table>

R-squared: 0.877  Mean dependent var: 13.880
Adjusted R-squared: 0.846  S.D. dependent var: 0.562
S.E. of regression: 0.221  Akaike info criterion: 0.008
Sum squared resid: 2.439  Schwarz criterion: 0.480
Log likelihood: 13.742  F-statistic: 27.541
Durbin-Watson stat: 1.969  Prob(F-statistic): 0.000

A null hypothesis of no effect between heritage significance rating and price is tested:

H₀: βHERSIGNIFICANCE = 0    and    H₁: βHERSIGNIFICANCE ≠ 0

The estimated value of βHERSIGNIFICANCE is 0.047. The null hypothesis is rejected at 1% significance level. It is evident that heritage significance plays a role in determining prices. Broadly speaking a property at the high end of the scale (i.e. with rating 10) is
likely to have a price which is on average 47% higher than a comparable property on the low end of the scale (i.e. with a rating 1). While interpreting the results of this analysis it must be remembered that there is no objective measure of heritage significance. Given the ordinal nature of the scale used in this study to rate heritage houses, the estimated $\beta_{\text{HERSIGNIFICANCE}}$ can be used only as an indication of the strength of the relationship between heritage significance and price. Unlike in case of objectively measured attributes like area, number of rooms, traffic levels etc. an implicit price for heritage significance cannot be imputed.

6. Conclusions

The study conclusively establishes that heritage-listed houses in Ku-ring-gai enjoy a price premium compared to unlisted houses. After controlling for other property attributes, heritage-listed houses commanded a premium of 12% on average$^{17}$. This premium reflects the combined value that the market places on their heritage character, their architectural style elements, and their statutory listing status. The market in Ku-ring-gai also differentiates among varying levels of heritage significance by conferring a higher premium to houses with a higher level of significance to the society. In sum, this market appears to support conservation of heritage-listed houses.

While these findings are based on data from Ku-ring-gai, they may be applicable to other regions with comparable markets. In this context two elements of the Ku-ring-gai housing market are noteworthy - the demographic, socio-economic and ethnic profile of its residents, and the residential planning policies of its local government. As discussed in

$^{17}$ While using this figure, a note must be made of the wide variability or spread of house prices around the average in the market studied.
Section 3.1, this community enjoys a higher level of socio-economic achievement compared to many others in Sydney. There is a predominance of people with English ancestry. The community is also characterised by an emphasis on family oriented households. Preference for Federation and Interwar heritage houses, as observed in this study, must be read in the context of these community characteristics. The local residential development planning policies of Ku-ring-gai also appear to have shaped the market preference for heritage. Residential development policies directly impact on the opportunity costs of owning a heritage-listed house. Planning policies which permit high-density development on unlisted properties are likely to drive up land values and hence the opportunity costs thereby lowering net benefits to heritage home owners. Planning policies in Ku-ring-gai have favoured low density housing in general. The opportunity for unlisted homeowners to capitalise on land by subdividing and developing multiple housing is limited. Council development control plans require that “development should conserve and enhance the visual character of the street with particular reference to the integrating of architectural themes, building scale and setbacks, landscaping themes…”18. This has provided a favourable environment for heritage houses and perhaps contributed to the observed positive price differential.

References


National Trust of Australia, N.S.W, 1996, “Housing in N.S.W between the wars”, prepared for the National Trust of Australia (NSW) by Robertson & Hindmarsh Pty Ltd.


N.S.W. Heritage Office, and Department of Urban Affairs and Planning 1996, “Conservation Areas, guidelines for managing change in heritage conservation areas ”.


Shipley, R., 2000, “Heritage Designation and property values: is there an effect?”, International Journal of Heritage Studies, 6, 1, 83-100.