Hedonic property pricing

Introduction

Hedonic pricing is the study of multi-correlation between environmental characteristics of a good and its sales price. The Hedonic property pricing (HPP) method can be used to estimate monetary values for ecosystem services that directly affect 'amenities' of properties which in turn are reflected in property prices. The HPP method requires large data sets of property sales statistics with physical characteristics of the property itself - and particularly for ecosystem services - e.g. characteristics of green infrastructure in the neighbourhood. Proximity and accessibility to green structures must be calculated using GIS. GIS data of high resolution is needed if the analysis is also to capture quality of green infrastructure, which is key to linking the analysis to ecosystem services. Econometric methods are used to control for differences in property and neighbourhood characteristics. In particular, spatial regression techniques are used to control for spatial auto-correlation between neighbourhood characteristics related to green infrastructure, and other non-environmental characteristics.

Keywords

Property prices: Amenities: Spatial analysis: Awareness raising.

Why would I chose this approach?

HPP is potentially powerful for *awareness raising* purposes because it can demonstrate to individual property owners the increase in private market values of public goods from green infrastructure amenities (whether public or private property). While marginal values for a specific green space on a given property may be small, aggregating values across all properties in the neighbourhood of a green space can show large total values, which may compete with real estate values of developing the green space. However, there are few applications of HPP to actual land-use & zoning decisions. Perhaps this is due to few studies using GIS data that controls for site qualities, and problems in finding robust econometric hedonic price functions because of spatial auto-correlation.

The spatial scale at which HHP works best is for whole urban areas with a high spatial density of property sales and large variability in availability of green infrastructure across neighbourhoods. The HPP method cannot distinguish directly between ecosystem services, but rather between the relative importance's of different green infrastructures. The link from a property's green structures to ecosystem functions has to be inferred using other data (e.g. green spaces may mitigate property flood risk as well as provide recreation). Such ecosystem functional inferences are easier if it the spatial resolution of the analysis is good enough to include qualities of green infrastructure, other than proximity affect prices. However, neighbourhood amenities that are directly perceivable to house buyers are those likely to affect prices, typically related to cultural ecosystem services.

What are the main advantages of the approach?

- Recognised and established approach;
- Potentially compatible with national accounting standards;

- Draws on existing data;
- Covers wide range of ES;
- Uncertainty can be addressed;
- Provides capital values of ES directly for use directly in natural capital accounting;
- Provides both public and private economic rationales for providing ecosystem services /amenities from green infrastructure;
- Can be linked directly to land use zoning proposals.

What are the constraints/limitations of the approach?

- Requires large panel data sets of property sales data;
- Requires extensive GIS pre-processing of neighbourhood characteristics;
- Results are sensitive to modelling assumptions regarding spatial auto-collinearity.

What types of value can the approach help me understand?

Hedonic property pricing is highly appropriate to elicit monetary values, direct use values and anthropocentric instrumental values related to the benefits of nature. They are not suitable to elicit intrinsic values of nature as well as bequest and existence values. They also have limitations to grasp ecological values, indirect use values and option values.

How does the approach address uncertainty?

Hedonic pricing uses multi-variate methods which make it possible to test whether variables explaining property prices are statistically significant. The covariance between green space characteristics and other urban neighbourhood characteristics can be evaluated. Confidence intervals for the marginal contribution of each characteristics of green space to property prices can also easily be calculated.

How do I apply the approach?

The flowchart below provides with a short description of the steps to apply hedonic property pricing. The steps can roughly be divided in two parts. The first analytical part (steps 1-3) organises the data, conducts the spatial statistical analysis and estimates the marginal individual contributions of each property characteristics. This is often as far as many research papers take the analysis. The second application part (steps 4-6) will vary depending on the decision context. In the flowchart below the steps relate to using the method for finding aggregate values for awareness-raising purposes.
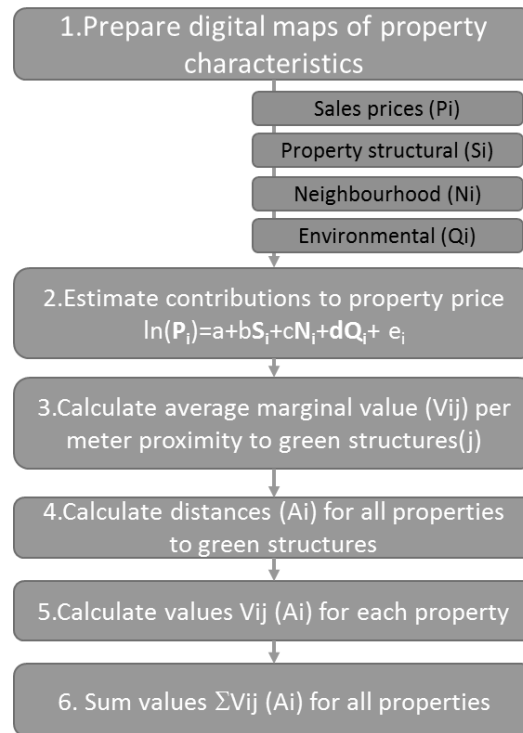
```
┌─────────────────────────────────────┐
│  1.Prepare digital maps of property  │
│            characteristics           │
└─────────────────────────────────────┘
              ┌──────────────────────┐
              │   Sales prices (Pi)  │
              ├──────────────────────┤
              │ Property structural (Si) │
              ├──────────────────────┤
              │  Neighbourhood (Ni)  │
              ├──────────────────────┤
              │   Environmental (Qi) │
              └──────────────────────┘
┌─────────────────────────────────────┐
│  2.Estimate contributions to property price │
│   ln(Pi)=a+bSi+cNi+dQi+ ei           │
└─────────────────────────────────────┘
┌─────────────────────────────────────┐
│ 3.Calculate average marginal value (Vij) per │
│  meter proximity to green structures(j) │
└─────────────────────────────────────┘
┌─────────────────────────────────────┐
│ 4.Calculate distances (Ai) for all properties │
│         to green structures          │
└─────────────────────────────────────┘
┌─────────────────────────────────────┐
│  5.Calculate values Vij (Ai) for each property │
└─────────────────────────────────────┘
┌─────────────────────────────────────┐
│  6. Sum values ΣVij (Ai) for all properties │
└─────────────────────────────────────┘
```

Box 2 equation: $\ln(P_i)=a+bS_i+cN_i+dQ_i+ e_i$

Figure 1. Stepwise approach to the HPP method

Requirements

Requirements		Comments
Data collection requierement	☐ Data is available ☐ Need to collect some new data (e.g. participatory valuation) ☐ **X Need to collect lots of new data** (e.g. valuation based on surveys)	
Type of data required	**X Quantitative** ☐ Qualitative	
Expertise and production of knowledge needed	☐ Working with researchers within your own field **X Working with researchers from other fields** ☐ Working of non-academic stakeholders	
Software requirements	**X Freely available** ☐ License required ☐ Advanced software knowledge required	For example "R"
Time requirements	☐ Short-term (less than 1 year) **X Medium-term (1-2 years)** ☐ Long-term (more than 2 years)	If property sales data is available
Economic resources	☐ Low-demanding (less than 6 PMs) **X Medium-demanding (6-12 PMs)** ☐ High-demanding (more than 12 PMs)	If property sales data is available
Other requirements	-	

OpenNESS

Where do I go for more information?

Contact: david.barton@nina.no

Baranzini, A., Ramirez, J.V., Schaerer, C. & Thalmann, P. 2008, "1. Basics of the HedonicPrice Model" in *Hedonic methods in housing markets. Pricing environmental amenities and segregation*, eds. J.V. Ramirez, A. Baranzini, C. Schaerer & P. Thalmann, Springer, pp. 1-12.

Barton, D. N., Stange, E., Blumentrath, S., Vågnes Traaholt, N. (2015a). Economic valuation of ecosystem services for policy. A pilot study on green infrastructure in Oslo. NINA Report 1114, 77p. http://www.openness-project.eu/node/78

Barton, D. N., Vågnes Traaholt, N. Blumentrath, S., (2015b). Materials and methods appendix for valuation of ecosystem services of green infrastructure in Oslo.– NINA Rapport 1115. 65 pp. http://www.openness-project.eu/node/78.

Brander, L.M. & Koetse, M.J. 2011, "The value of urban open space: Meta-analyses of contingent valuation and hedonic pricing results", *Journal of environmental management,* vol. 92, no. 10, pp. 2763-2773.

Garrod, G.D. & Willis, K.G. 1992, "Valuing goods' characteristics: An application of the hedonic price method to environmental attributes", *Journal of environmental management,* vol. 34, no. 1, pp. 59-76.

Mueller, J.M. & Loomis, J.B. 2008, "Spatial dependence in hedonic property models: do different corrections for spatial dependence result in economically significant differences in estimated implicit prices?", *Journal of Agricultural and Resource Economics,* vol. 33, no. 2, pp. 212-231.

Palmquist, R.B. 2005, "Chapter 16 Property Value Models" in *Handbook of Environmental Economics*, eds. K. Mäler & J.R. Vincent, Volume 2 edn, Elsevier, , pp. 763-819.

Reinvang et al. (2014) Verdi av urbane økosystemtjenester: Fire eksempler fra Oslo. VISTA, NINA, Framtidens Byer. Vista Analyse AS Rapport nummer 2014/46

Taylor, L.O. 2003, "The hedonic method" in *A primer on nonmarket valuation*, eds. P.A. Champ, K.J. Boyle & T.C. Brown, Springer, Netherlands, pp. 331-393.

Factsheet prepared by David N. Barton and Anders L. Madsen