

The economic valuation of urban green spaces as a voice in the debate over their role in sustainable cities¹

Piotr CZEMBROWSKI

University of Łódź, Poland

Abstract: Recognizing social preferences seems to be crucial for successful spatial planning of urban green spaces. Economic valuation is one way to recognize these preferences. In this paper I analyze and draw common conclusions from three hedonic pricing researches conducted recently in Łódź which reveal the economic potential of green spaces and highlight the multidimensionality of their value. These comparable studies analyze the impact of green spaces on apartment sale prices. Each of them emphasizes different attributes or features of green spaces, such as their area, social perception and biocultural value. Together they draw a complex picture of people's preferences towards urban green spaces and constitute the platform for further discussion on the role of green spaces in sustainable cities of the future.

Keywords: economic valuation, integrated valuation, hedonic pricing, urban green infrastructure, sustainable development

JEL codes: Q01, Q51, R32

1. Introduction

Taking into account the voice of society seems to be a necessary element of effective

¹ The study described in this article was conducted within the GREEN SURGE EU FP7 collaborative project, FP7-ENV.2013.6.2-5-603567. Polish contribution was co-financed with national funds for scientific research providing national input into international projects (granted by the Ministry of Science and Higher Education for the period 2013–2017). The study was performed within the cooperation agreement between Łódź City Geodesy Center and the Faculty of Economics and Sociology of University of Łódź in the field of the real estate market analysis of Łódź.

governmental decision making. The understanding of this is rising and is emphasized in international agreements like Agenda 21 adopted in Rio de Janeiro in 1992 or the Aarhus Convention adopted in 1998. It seems particularly relevant in the case of spatial planning of urban green spaces. Even economists developed various methods of recognizing people's preferences towards non-market goods and services which are collectively referred to as economic valuation (Murzyn-Kupisz, 2010: 381). These methods can either reveal the preferences based on the market ("revealed preferences") or simply collect the statements of the respondents ("stated preferences"); some may demonstrate the perceived value of green spaces in monetary terms, others – often spanning beyond economics – in non-monetary. Hedonic pricing, the method I chose for demonstrating the preferences of inhabitants of Łódź, represents the monetary, "revealed preferences" methods. The aim of this article is to collect the knowledge and draw common conclusions from three studies performed in Łódź, Poland and as a result present the possibilities of hedonic pricing to recognize people's preferences towards various attributes of urban green spaces.

Hedonic pricing is an econometric method of dividing the price of the composite good into the values of its components. It allows to recognize the value of components or even the features of the final product which alone are not subject to trade, thus do not have a price. Actually hedonic pricing has not been designed specifically to value green spaces, first hedonic pricing studies were conducted to recognize the components of the price of agricultural land (Haas, 1922: 3) or a car (Goodman, 1998: 291). However, since the 1970s the economic valuation of nature based on real estate prices has become one of the most popular application of hedonic pricing. Valuation of green spaces with the use of hedonic pricing is based on the assumption that one of the factors affecting property prices is the quality/availability of the natural environment around a property. Then the hedonic pricing model generally takes the form:

$$P = \alpha S + \beta E + \gamma L + \varepsilon$$

Where P is a vector of property prices, S , E and L – the vectors of respectively: structural, environmental and locational attributes, ε is the random error and α , β and γ are the estimated coefficients which can be interpreted as marginal willingness to pay for attributes they stand by (the most interesting part). Usually environmental attributes of the properties are represented by

the distance to the nearest green space or the share of greenery in a buffer around the property (Melichar and Kaprová, 2013: 59; Nicholls and Crompton, 2005: 322; Tyrväinen and Miettinen, 2000: 211). Also the air, water or noise pollution indexes have been used in specific studies (Bayer et al., 2009: 17; Chattopadhyay, 1999: 22; Kim et al., 2007: 275; Łowicki and Piotrowska, 2015: 472; Smith and Huang, 1995: 209). Typically, it is expected that high quality or availability of natural environment is associated with an increase of the property price. And typically this hypothesis is verified positively: Tyrvainen (1997: 218) found that growing distance to the nearest water course decreases the property price in Joensuu, Finland; Larson and Perrings (2013: 50) observed the significant increase in the property price in the vicinity of large parks and water bodies in Phoenix Metropolitan Area. However, the same papers state that the wooded recreation area seems to be perceived as a disamenity as its closeness decreases the property price (Tyrväinen, 1997: 218) and similarly do small parks and agricultural land according to Larson and Perrings (2013: 50). Sometimes the environmental attributes turn out to be insignificant in explaining the variability of property prices as it was in 14 out of 38 cases analyzed by Luttik (2000: 164) in the Netherlands. Still, most hedonic pricing studies reveal positive impact of green spaces on property prices.

The number of hedonic pricing studies in Poland has been very limited in comparison to those conducted in the USA and Western Europe. Borkowska et al. performed a hedonic pricing study on four different real estate markets in Warsaw: house sales, apartment sales, house rentals and apartment rentals. The authors found that “green areas seen from windows at one side of a building correlated with higher apartment prices and house rental prices” whereas “houses immersed in green were rented at somewhat lower prices than those with one green side only” (Borkowska et al., 2001: 79-80). Also the closeness of small green spaces turned out to reduce the selling price in the house markets while the easy access to green areas was considered an advantage. This study provides a good example of how inhomogeneous the results can be when it comes to environmental attributes. The study conducted by Bazyl (2009) also took place in Warsaw. The main focus of the paper was to analyze the impact of the locational factors, including green spaces. While the standard model revealed that property prices are influenced by their proximity (increase of the flat price by 4% if the green spaces are within 1 km distance), the inclusion of the spatial autocorrelation component deprived the green spaces variable of significance. Two studies were conducted by Łowicki in Poznan Metropolitan Area. The first

revealed the positive impact of lakes and forests on the prices of both building plots (Łowicki, 2010: 153). The second study showed that increasing the distance to cultivated greenery and coastal areas reduces the agricultural land intended for conversion into building plots value by respectively 17 PLN and 10 PLN for every 1000 meters (Łowicki, 2012: 172). The most recent hedonic pricing study that took place in Poland, (Zygmunt and Gluszak, 2015) was focused on one green space only, the Wolski forest in Krakow. The study revealed the positive impact of forest proximity on undeveloped property prices: the 100 m increase in distance decreases the price by approximately 3%.

The next section provides the overview of hedonic pricing studies conducted in Łódź and is followed by the discussion of results and the general potential of hedonic pricing to recognize the value of different attributes of green spaces. Section 4 concludes.

2. Overview of hedonic pricing studies conducted in Łódź

All three hedonic pricing studies which I am going to discuss in this paper were conducted on the same dataset of apartments traded in Łódź in years 2011-2013. Łódź is the third largest city in Poland inhabited by 710 000 people and covering the area of 293 km², 13% of which is formally classified as green space divided into: 32 forests (which cover 1920 ha), 107 parks (846 ha), 109 allotment gardens (694 ha) and 18 cemeteries (205 ha).

The real estate data come from the City Center of Geodesy and contain more than nine thousand selling prices together with some information on each apartment sold: living area, age of the building, the story on which the apartment is located. Also the City Center of Geodesy provided data on the locations of formal green spaces in Łódź: parks, forests, cemeteries and allotment gardens. In each paper I analyzed the changes in apartment price in response to the change in the distance to the nearest green space of given type. The distances used were either along the path (article 1&2) or Euclidean (article 3).

The first of the articles written together with Jakub Kronenberg differentiated the impact of green spaces on property prices according to their type and size and to discuss the possibilities to apply hedonic pricing to the ecosystem services framework (Czembrowski and Kronenberg, 2016: 11). The concept of ecosystem services is based on the distinction between the goods and services provided by nature. The services, although less visible are equally necessary to sustain

the life on Earth. The Millennium Ecosystem Assessment introduced the division of ecosystem services into provisioning, regulating, supporting and cultural.

In order to compare the impact of green spaces of different types and sizes both parks and forests were divided into three size categories: large (more than 200,000 m^2), medium (18,000–200,000 m^2) and small (less than 18,000 m^2). Łagiewniki forest which covers the area of 13,000,000 m^2 was treated separately. The cemeteries and allotment gardens were not divided into size groups. Then the shortest distance to the nearest entrance of green space of each type was calculated with the use of Google Distance Matrix API. After the set of variables was completed we estimated the influence of the closeness of these green spaces with the use of spatial autoregressive model with a spatial autoregressive disturbance as we expected that both the apartment prices and their characteristics might be spatially autocorrelated. The results showed that Łagiewniki forest, small forests and large parks as well as the percentage of greenery in a radius were considered as amenities, whereas cemeteries were seen as unwelcome. More specifically: a one percent increase of the distance to the Łagiewniki forest translated on average into the decrease of the price of an apartment by 110 PLN per square meter. For small forests it was 107 PLN and for large parks 57 PLN. The 1% increase in the distance to the nearest cemetery was welcome with financial gratification of 61 PLN per square meter. What's surprising the other types of green spaces were not associated with any impact on property prices.

Despite our efforts we found it impossible to apply hedonic pricing to the ecosystem services concept although some researchers claim that such valuation of ecosystem services is feasible. The first and most important reason is that the apartment buyers do not understand the concept of ecosystem services and for sure it does not play a role in their decision-making process. Secondly there is a lack of variables that could accurately measure individual ecosystem services. For these two reasons we recommend to use the traditional concept of environmental amenities when performing a hedonic pricing study.

The second study, performed with Jakub Kronenberg and Michał Czepkiewicz, was aimed at addressing the growing need for integration of different valuation techniques, therefore apart from monetary hedonic pricing it employed the non-monetary public participatory softGIS questionnaire (Czembrowski et al., 2016a: 166). In softGIS the respondents are asked about places and their answers are marked on interactive map. After the questionnaire is over the

sample of answers can be spatially analyzed. In our case the respondents were asked to point green spaces where they like to spend time and other valuable green spaces, along with unkept green spaces, badly designed green spaces and places with not enough greenery. The number of markings of each type assigned to formal green spaces allowed us to divide them into 3 categories: green spaces of “high perceived value”, of “no net preference” and of “low perceived value”. The information on informal places (lacking the established boundaries) was also used: the kernel density estimation formed the clusters of positive and negative markings. Once again the shortest distances were calculated, though this time it was done with ArcGIS program. Finally, when the set of variables was ready (analogous to the one from previous study) the estimation of hedonic pricing model could be performed. In general the hypotheses of our study were verified positively: firstly the softGIS and hedonic pricing turn out to be compatible tools which together give more accurate information than the hedonic pricing only and secondly the conclusions from softGIS questionnaire were roughly confirmed by the monetary part of the study: formal green spaces of high perceived value tended to exert a positive impact on property prices whereas the green spaces of low perceived value exerted the negative impact. However the results turned upside down in regard to informal green spaces: those that were positively perceived had no impact on apartment prices whereas the places perceived negatively or simply lacking greenery were associated with higher property prices. This might be caused by the fact that informal places pointed out by respondents as lacking greenery are actually the best known places in Łódź.

The study showed it is possible to integrate monetary hedonic pricing with non-monetary softGIS. However it is worth noting that this integration still preserves the dominant role of hedonic pricing – the final results are still expressed in cash. Still this integration meets the requirements posed by Martin-Lopez et.al (2014: 220) to allow to recognize the trade-offs across value perspectives: the informal places perceived as unattractive or lacking greenery have stronger economic impact than the informal green spaces perceived as attractive. Finally this type of integration seems to meet the most important condition that we set ourselves: it is not just a random mix of valuation methods inheriting the flaws and limitations of the tools it employs but rather the integration where at least one of the method complements the other – in this case softGIS provided the useful a priori information about the people’s perception of green spaces so that it could be monetarily verified bringing the comparison of different value perspectives.

The third hedonic pricing study performed together with Edyta Łaszkiewicz and Jakub Kronenberg was also conducted in Łódź and focused on the concept of biocultural diversity understood as an effect of manifold processes that took place in the past and shaped the ecosystems that still exist (Czembrowski et al., 2016b: 89). This concept seems to be embodied in Łódź in the form of the Green Circle of tradition and Culture (GCTC), a ring-shaped complex of green spaces and postindustrial areas surrounding the city center (Elands et al., 2015). The hypothesis of this study was that the spaces characterized by high biocultural value exert higher impact on apartment prices than other. Therefore this study too allowed to spot the potential trade-offs between different value domains.

Due to the focus on the GCTC we limited the sample only to the city center and its surroundings – the number of observations fell from 9346 to 5018. This time the green spaces were categorized in accordance to the biocultural value they represent. Therefore the two green complexes that seem most valuable in these terms: the Priest's Mill and Łódka River Gardens were of our paramount interest and therefore constituted separate groups from the rest of GCTC. This time the estimations were done with the use of spatial quantile autoregression model, which allowed us to compare the differences in coefficients between different segments of the sample.

We found no support for the hypothesis of the study. Green spaces that seem particularly valuable in biocultural terms do not constitute any extra financial value to the owners of the apartments nearby. What is more, while Łódka River Gardens were found insignificant the closeness of Priest's Mill was associated with the fall in value of the apartments. However this might result from the specific neighborhood of the complex – old and neglected postindustrial buildings. The other green spaces belonging to GCTC were associated with higher property prices which shows that in general “greenery sells” but biocultural aspect is not necessary in this case.

3. Discussion

The three abovementioned examples show that hedonic pricing can be used to value the impact of various attributes of green spaces on property prices, not only their size, the criterion which is most commonly used in hedonic pricing literature. Although it is worth noting that size seems to be also the most intuitive one, the new applications of hedonic pricing (as well as other valuation

methods) are needed if the more multidisciplinary approach towards green spaces is expected. Both public participatory softGIS and biocultural value are concepts from beyond the field of economics and enrich the traditional monetary framework with a social and a biocultural perspective.

In order to address the call for creating a broader picture of urban green spaces, these studies seek for new ways of comparing different perspectives of value mainly to root the multidimensional way of perceiving green spaces and hopefully to assure that they are all considered and integrated into decision making processes. Creating linkages between concepts and methods makes it possible to establish the dialogue between various fields of science in common goal of proper management of urban green spaces which will allow to maximize the benefits derived from them in the sustainable cities of the future.

Problems, similarly as values are multidimensional and can be analyzed from various perspectives. The integrated approach can help to understand the problems and steer the path to solve them. The fact that several green spaces in Łódź do not exert a positive impact on property prices, even though the literature on hedonic pricing tells us they should do so, is intriguing. Thanks to integration with softGIS we know that the bad maintenance of these spaces is of matter. And the other way around: thanks to hedonic pricing we know that the badly maintained green spaces in Łódź are found unattractive by the inhabitants to such a level that they do not even consider the closeness to them as an amenity when negotiating the property sales price.

The comparison between studies focused on different perspectives of value of green spaces allows us to recognize the relation between them: where are the synergies between different values involved (which values go in pairs), where are the trade-offs (which values are mutually exclusive)? Which values seem to be worth paying for and which are completely out of scope of monetary valuation? As stated by Gomez-Baggethun (2014: 17) only when these questions are answered can we talk about the truly integrated valuation that could sufficiently inform decision making processes.

Here it should be mentioned that our attempts at integrated valuation have their limitations resulting from the sole nature of hedonic pricing: it captures the preferences only of these people that are able to buy the property, or are able to buy the property they truly want. Therefore, the voice of the less affluent part of the society is here imperceptible. This is a serious drawback of this method especially in the light of the concepts of eco-gentrification (the

displacement of lower income families and small businesses due to rising property values as a result of introducing greenery) and environmental justice (fair distribution of environmental benefits). For this reason, the conclusions from hedonic pricing only should not serve as a basis for decision making but instead be supported by other, preferably non-monetary methods. The last limitation is related to the case study city: the real estate market in Łódź, the post-socialist city is mature enough to reveal some relationships between the apartment prices and their characteristics but only the most obvious ones. We could imagine that such studies replicated in more mature markets could bring even more interesting conclusions.

Further research on enriching the hedonic pricing method could be to put more focus on different price segments with more advanced quantile regression analysis. This might seem particularly interesting from the point of view of the abovementioned eco-gentrification and environmental justice. Also performing the study the other way around – firstly identifying the spaces, closeness to which turns out to be perceived as an amenity, and then finding out what do they have in common – indicates another promising future research thread.

Apart from main aim of the valuation in general – the recognition of people's preferences – hedonic pricing gives also very specific information which should be taken into account by developers: that greenery sells. No wonder most of the real estate ads show Eden-like residential estates with smiling people taking their children for a walk or resting under a tree in bloom. Unfortunately the reality rarely meets such a vision (Bergier et al., 2013: 33). It is a common practice to firstly clear the construction site from trees and possibly plant new ones once the construction process is completed. Even if planted, the trees serve mainly as decoration rather than a necessary element of every human habitat. The situation might improve as the market matures and people's preferences on this matter become more expressive or when some regulations are implemented to force developers to satisfy these broader social needs.

4. Conclusions

Taking into account people's voice in decision making is an indispensable to create a sustainable and socially accepted city, although in practice it is not always given due consideration. Society needs to be engaged in the process of change so that the change is true and permanent. One of the tools allowing to recognize people's preferences towards urban green spaces is economic

valuation. In order to get the broader picture of values that green spaces represent it is recommended to integrate different perspectives and seek linkages between them. Such attempts have been done in the three hedonic pricing studies conducted in Łódź in the last two years. Analyzing different attributes of green spaces with hedonic pricing method – their size, perceived attractiveness and biocultural value – helped to understand the linkages between these attributes and their monetary value (approximated by the economic impact that green spaces exert on property prices). These studies show that the integration of monetary valuation with concepts from outside of economics is feasible and that the unexplored field of integrated valuation is full of possibilities that could further broaden our knowledge on green spaces.

Literature

- Bayer, P.; Keohane, N.; Timmins, C. (2009). Migration and hedonic valuation: the case of air quality. *Journal of Environmental Economics and Management* 58(1): 1–14.
- Bazyl, M. (2009). *Hedonic Price Model for Warsaw Housing Market*. Warsaw: Department of Applied Econometrics, Warsaw School of Economics. Available at: <https://ideas.repec.org/p/wse/wpaper/42.html>. Accessed 27 April 2016.
- Bergier, T.; Kronenberg, J.; Lisicki, P. (2013). *Zrównoważony Rozwój — Zastosowania; Przyroda W Mieście — Rozwiązania*. Fundacja Sendzimira.
- Borkowska, M.; Rozwadowska, M.; Śleszyński, J.; Żylicz, T. (2001). Environmental amenities on the housing market in Warsaw: hedonic price method research. *Ekonomia* 3: 70–82.
- Chattopadhyay, S. (1999). Estimating the demand for air quality: new evidence based on the Chicago housing market. *Land Economics* 75(1): 22–38.
- Czembrowski, P.; Kronenberg, J. (2016). Hedonic pricing and different urban green space types and sizes: Insights into the discussion on valuing ecosystem services. *Landscape and Urban Planning* 146: 11–19.
- Czembrowski, P.; Kronenberg, J.; Czekiewicz, M. (2016a). Integrating non-monetary and monetary valuation methods – SoftGIS and hedonic pricing. *Ecological Economics* 130: 166–175.
- Czembrowski, P.; Łaskiewicz, E.; Kronenberg, J. (2016b). Bioculturally valuable but not necessarily worth the price: Integrating different dimensions of value of urban green spaces. *Urban Forestry & Urban Greening* 20: 89–96.
- Elands, B.H.M.; Wiersum, K.F.; Buijs, A.E.; Vierikko, K. (2015). Policy interpretations and manifestation of biocultural diversity in urbanized Europe: conservation of lived biodiversity. *Biodiversity and Conservation*, 24(13): 3347–3366.
- Gómez-Baggethun, E. et al. (2014). *State-of-the-Art Report on Integrated Valuation of Ecosystem Services*. Barcelona: EU FP7 OpenNESS Project. Available at: http://www.openness-project.eu/sites/default/files/Deliverable%204%201_Integrated-Valuation-Of-Ecosystem-Services.pdf. Accessed 8 May 2015.
- Goodman, A.C. (1998). Andrew Court and the invention of hedonic price analysis. *Journal of Urban Economics* 44(2): 291–298.
- Haas, G.C. (1922). *Sale Prices as a Basis for Farmland Appraisal*. St. Paul: University Farm. Available at: <http://hdl.handle.net/2027/hvd.hne59k>. Accessed 8 May 2015.
- Kim, K.S.; Park, S.J.; Kweon, Y.-J. (2007). Highway traffic noise effects on land price in an urban area. *Transportation Research Part D: Transport and Environment* 12(4): 275–280.
- Larson, E.K.; Perrings, C. (2013). The value of water-related amenities in an arid city: The case of the Phoenix Metropolitan Area. *Landscape and Urban Planning* 109(1): 45–55.
- Łowicki, D. (2010). Wartość krajobrazu w świetle cen terenów pod zabudowę w latach 1995–2000. *Ekonomia i Środowisko* 37: 147–156.

- Łowicki, D. (2012). Land prices as an indicator of the recreational services of ecosystems. *Ekonomia i Środowisko* 42: 167–175.
- Łowicki, D.; Piotrowska, S. (2015). Monetary valuation of road noise. Residential property prices as an indicator of the acoustic climate quality. *Ecological Indicators* 52: 472–479.
- Luttik, J. (2000). The value of trees, water and open space as reflected by house prices in the Netherlands. *Landscape and Urban Planning* 48(3–4): 161–167.
- Martín-López, B.; Gómez-Baggethun, E.; García-Llorente, M.; Montes, C. (2014). Trade-offs across value-domains in ecosystem services assessment. *Ecological Indicators* 37: 220–228.
- Melichar, J.; Kaprová, K. (2013). Revealing preferences of Pragues homebuyers towards greenery amenities: the empirical evidence of distance-size effect. *Landscape and Urban Planning* 109(1): 56–66.
- Murzyn-Kupisz, M. (2010). Sustainable approaches to natural environment and cultural heritage. Two sides of the same coin. *Economic and Environmental Studies* 10(4): 379–397.
- Nicholls, S.; Crompton, J.L. (2005). The impact of greenways on property values: Evidence from Austin, Texas. *Journal of Leisure Research* 37(3): 321–341.
- Smith, V.K.; Huang, J.-C. (1995). Can markets value air quality? A meta-analysis of hedonic property value models. *Journal of Political Economy* 103(1): 209–227.
- Tyrväinen, L. (1997). The amenity value of the urban forest: an application of the hedonic pricing method. *Landscape and Urban Planning* 37(3–4): 211–222.
- Tyrväinen, L.; Miettinen, A. (2000). Property prices and urban forest amenities. *Journal of Environmental Economics and Management* 39(2): 205–223.
- Zygmunt, R.; Gluszek, M. (2015). Forest proximity impact on undeveloped land values: A spatial hedonic study. *Forest Policy and Economics* 50: 82–89.

Wycena ekonomiczna miejskich terenów zieleni jako głos w debacie nad ich rolą w zrównoważonych miastach

Streszczenie

Uwzględnienie preferencji społeczeństwa wydaje się być kluczowe dla prawidłowego planowania przestrzennego miejskich terenów zieleni. Wycena ekonomiczna jest jedną z metod poznania tych preferencji. W tym artykule analizuję i wyciągam wspólne wnioski z trzech badań wyceny hedonicznej przeprowadzonych niedawno w Łodzi, które ujawniają ekonomiczny potencjał terenów zieleni oraz podkreślają ich wielowymiarową wartość. Te trzy porównywalne badania analizują wpływ terenów zieleni na ceny mieszkań. Każde z nich kładzie nacisk na inny atrybut lub cechę terenów zieleni jak ich rozmiar, społeczne postrzeganie czy wartość biokulturową. Razem tworzą one kompleksowy obraz preferencji mieszkańców miasta względem terenów zieleni i stanowią platformę dla dalszej dyskusji nad rolą terenów zieleni w zrównoważonych miastach przyszłości.

Słowa kluczowe: wycena ekonomiczna, zintegrowana wycena, wycena hedoniczna, zielona infrastruktura, zrównoważony rozwój