

## Typology of green space

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An urban area consists of the built environment and the external environment between buildings. The external environment is composed of two distinct spaces: ‘grey space’ and ‘green space’. Grey space is land that consists of predominantly sealed, impermeable, ‘hard’ surfaces such as concrete or tarmac. Green space, whether publicly or privately owned, consists of predominantly unsealed, permeable, ‘soft’ surfaces such as soil, grass, shrubs, trees and water. In this article we focus on green spaces in the urban environment. Urban green space is costly to provide because alternative use of the land could generate high private benefits. Therefore the value of urban green space is an important topic of research.

Existing research based on the hedonic method has yielded varied results spanning from large effects on house prices to insignificant or even negative effects. One possible reason for the diverse results could be that there has been very little focus on different types of urban green space in the existing research. In this paper urban green spaces are divided into distinct typologies related to the positive and negative externalities associated with them.

1. Parks and gardens
2. Natural and semi-natural spaces
3. Green space dominated by lakes
4. Small, local recreational areas and green corridors
5. Outdoor sports facilities
6. Cemeteries, disused churchyards and other burial grounds
7. Cultivated fields and grassed meadows
8. Green space related to infrastructure, industrial areas and scrap lands

The typologies reflect a hierarchy of recreational and amenity services provided by the urban green spaces. Each typology differs in terms of services provided as well as level of service provided. We estimate the impact on house prices of access to green space and find evidence that the value of different types of green space varies substantially. In particular, we find that access to open space in cities can be associated with both significantly higher and lower housing prices depending on the type of open space. Our results suggest that aggregation of different types of green space may lead to wrong conclusions about the benefits of green space provision.

Our paper also addresses robustness of estimates with regard to different models of the spatial variation in housing prices. Hedonic models are often subject to omitted variable bias and spatially correlated errors. This paper utilizes an approach to account for spatial correlation which to our knowledge is novel to the literature on hedonic regressions. We model location as a nonparametric function of the geographic coordinates which allows us to capture a large part of the spatial variation

in the data. The approach is easy to implement using existing software in R and allows easy visualization of the value of “location” on a map enabling the researcher to validate the resulting spatial structure visually. However, challenges connected with spatially varying data remain in the sense that choice of flexibility in the spatial structure affects estimated parameters of some spatially varying characteristics markedly. This suggests that omitted variables bias may play a role in explaining the variation in estimated WTP from existing green space studies. We advocate an increased use of sensitivity analysis to determine robustness of estimates to different models of the (omitted) spatial processes.

Our data cover transactions in the residential market of Aalborg, Northern Denmark, from 2000 to 2007. In total we have a sample of 14.000 transactions divided equally between single family or terraced housing and apartments. The data on housing characteristics (size of living area, age, etc.) derives from the OIS-register, whereas the spatial data has been calculated based on coordinates of each dwelling using Geographical Information Systems, maps and aerial photographs.

We find differences in the capitalization of different types of open space between apartments and houses. The findings indicate that distinguishing between different types of open space is important and suggest that further research is needed to determine what makes open space desirable to residents in different types of homes. Our findings for single family and terraced housing indicate robust price premia (approx. 7 percent) associated with a view of lakes and robust negative association (approx. -1.8 percent) to adjacency to small, local recreational areas and green corridors. For apartments, a robust price premium was found for view (5 percent) and proximity to parks (1.3 percent per 100 m increased proximity) and additionally for access to natural areas (1.5 percent per 100 m increased proximity). Interestingly the size of small, local recreational areas is associated with a positive price premium (1.3 percent per ha) for apartments in contrast with the findings for houses. Finally one type of green space was found to be associated with a robust negative effect for both houses (approx. -2.2 percent per 100 m increased proximity) and apartments (approx. -1.7 percent per 100 m increased proximity) within 300 m distance of scrap lands.