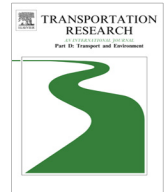




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The effect of road traffic noise on the prices of residential property – A case study of the polish city of Olsztyn



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ABSTRACT

The key factors that determine the prices of real estate are location, technical standard of property as well as the local environment. In urban agglomerations, road traffic noise has a considerable impact on the purchasing decisions made by apartment buyers. This is a widespread problem in Central-Eastern Europe. The main objective of this study was to verify the working hypothesis that apartment prices are correlated with traffic noise levels in Olsztyn, the capital city of the Region of Warmia and Mazury in north-eastern Poland.

The study was carried out in four principal stages. Firstly, traffic noise intensity was determined for apartments (objects of real estate transactions concluded in 2013), based on an acoustic map for the city of Olsztyn. The map was developed in line with the provisions of Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise. Secondly, the values of the Noise Depreciation Sensitivity Index (NDSI) were calculated. NDSI determines the percentage change in property prices per dB increase in noise levels. The distribution of unit prices of apartments was mapped relative to noise levels, and the relationships between the analyzed variables were assessed. Thirdly, linear correlations between the unit prices of apartments and noise levels were analyzed. The strength and direction of relationships between the analyzed parameters were determined based on Pearson's correlation coefficient. In the last stage, the distribution of the unit prices of apartments was mapped by ordinary kriging, a geostatistical estimation method. The research hypothesis was confirmed by comparing the spatial distribution of traffic noise levels measured in stage 1 with the spatial distribution of apartment prices.

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Introduction

A landscape is generally regarded as a visual phenomenon, but local scenery can also be experienced with the involvement other senses: hearing, smell and even touch. This approach is referred to as multisensory landscape perception. Research results indicate that the visual landscape is complemented by an acoustic landscape where visual experiences are enhanced through sound. The acoustic environment is studied by various fields of science, including musicology, cultural anthropology, physics and geography. The concept of a multisensory landscape emerged in the 1980s. In this approach, landscape is perceived not only as the visual reality, but also as the acoustic reality, where sound is an additional stimulus that complements a sensory experience.

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Soundscape is a term that describes the acoustic environment. The concept was introduced by Schafer in the 1970s, and it was fully explored in his book, *The Tuning of the World*, published in 1977. In his studies of soundscape evolution, Schafer describes urban soundscapes as complex sonic environments and as cues about socio-cultural life throughout history (Raimbault and Dubois, 2005). In line with a different approach, “soundscape shall be defined tentatively as the totality of sound phenomena that lead to a perceptual, esthetic and representational comprehension of the sonic world” (Augoyard et al., 1999). This definition of sound, an element of the local landscape, spurred research aiming to analyze various sound qualities. In this context, sound is most often associated with noise. Road traffic noise, in particular in an urban setting, is recognized as one of the greatest annoyances in literature (Hedfors, 2003; Raimbault and Dubois, 2005; Yang and Kang, 2005). Urban dwellers search for residential locations that are removed from sources of noise, mostly heavily traveled highways, industrial plants and large retail outlets.

Traffic noise is regarded to be one of the main environmental problems in Europe. The achievement of a high level of health and environmental protection is one of the objectives of European Union policy, and the relevant goals are outlined in *Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise*. In the light of the above Directive, Member States are under obligation to monitor the acoustic environment and develop protection programs for areas where noise levels exceed the allowable limits. In Poland, acoustic maps are developed and updated pursuant to the provisions of environmental protection laws. The above measures support assessment of exposure to noise, identification of noise sources and areas that are particularly susceptible to noise. Acoustic maps combined with information about real estate prices provide reliable data for evaluating the effects on noise on transaction prices and real estate values.

The objective of this study was to evaluate the correlation between noise emissions and prices on the local real estate market in Olsztyn, the capital city of the Region of Warmia and Mazury in north-eastern Poland. Two residential estates comprising apartment blocks were analyzed. The first estate is situated in a downtown area characterized by high road traffic intensity. The second estate is set remotely from the city center, but it is adjacent to a main transit corridor that connects the downtown area with the largest housing districts.

Literature review

Soundscape

Urban centers have always been the main sources of noise pollution. Cities traditionally combine various types of human activity and functions, and they are characterized by high population density. Throughout centuries, the expansion and introduction of new urban functions and continued population growth created new sources of noise and increased noise levels. Civilizational change contributes to growing levels of noise pollution in the environment. Most urban components, including people, produce noise which makes up the city's acoustic landscape. The urban soundscape comprises background noise, sounds produced by mechanical equipment, human activity and human presence, speech, communication and noises of nature (Garrioch, 2003; Kang and Servign, 1999; Lebidowska, 2005; Neudorf, 2009). The acoustic landscape has to be analyzed in a broader context of different sensory experiences and our knowledge of the surrounding space (Botteldooren et al., 2011; Raimbault and Dubois, 2005; Yang and Kang, 2005).

Some sounds which are an intrinsic element of the urban landscape are regarded as noise which is a source of annoyance. The most common sources of urban noise are road traffic, rail traffic, air traffic and sites of industrial activity (De Coensel et al., 2005; Dubois et al., 2006; Garrioch, 2003; Raimbault and Dubois, 2005).

Not all urban are perceived negatively, and some sounds have positive connotations and can contribute to the quality of the urban soundscape. Sounds of nature and their sequences (melodies) lead to positive perceptions of space. They are an important component of emotional experiences that create the atmosphere of a place (Bernat, 2011).

In a Polish study conducted with the use of a multiple choice questionnaire, the respondents' favorite natural sounds were chirping of birds (90.9%), gushing water (21.2%) and rustling of trees (24.2%). Unpleasant sounds included traffic and machine noise (55.2% and 39.9%, respectively), urban noise (13.8%), followed by sounds of sudden weather phenomena, shooting sounds, arguing, shouting, loud music, fire engine and police car sirens (Kowalczyk, 2008).

Road traffic noise and its consequences

The urban environment is permeated by the noise of human activity, including traffic noise. Road traffic noise is caused by two main factors: tire-pavement interactions and noise generated by a vehicle's engine and exhaust system. According to estimates, tire-pavement interactions are the main source of road traffic noise produced by passenger cars traveling at speeds higher than 55 km/h and goods vehicles moving faster than 70 km/h (subject to vehicle weight, age and weather conditions). Noise levels, noise tolerance and the effect of noise on the human auditory system are determined by a combination of factors. Noise levels higher than 55 dB can be a source of annoyance, and the allowable noise limit is set at 65 dB. According to statistical data, around 250 million Europeans suffer from noise-related disturbances (Directive 2002/49/EC.,.,., 2002; OECD Environmental.,.,., 2008).

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