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Monetary valuation of road noise. Residential property prices as an indicator of the acoustic climate quality

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ABSTRACT

Soundscape as an inherent part of landscape provides ecosystem services, first of all spiritual and symbolic services as well as educational and esthetic ones. The value of these services depends on the ability to hear sounds of nature. However, more often people can hear only sounds generated by humans and those generated by organisms and the physical environment become very desirable. Reports of the European Commission confirm that the noise in the environment is a very serious threat to public health and that the noise exposure in Europe is increasing. It is estimated that the main threat to the acoustic climate is road noise, both in the cities and outside them. Although the soundscape is a non-market good, the attempts of its evaluation have been increasing, usually by estimating the economic costs arising from exposure to noise: lost productivity, medical expenses, decreases in revenues from tourism. The authors used the hedonic pricing method to estimate the decline in undeveloped property prices associated with road noise around the city of Poznan. To extract the effects of noise also other factors that contribute to the land price were considered. The model chosen by using multiple regression showed, that plots located in the zone with noise exceedance at night were about 57% cheaper than those located outside this zone. The results can be helpful in spatial planning, especially for estimating costs of road investments in environmental and economic impact assessments.

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1. Introduction

1.1. Noise in human life

Sound is a very important part of landscape. Together with the landscape development humans influenced sources of sounds, and at the same time sounds, created by humans, influenced humans. Since the beginning of human civilization sounds have had different functions, i.e. they marked the extent of a territory (trumpets/horns), have set rules for life in cities (bells, clocks) and more importantly, they gave information about dangers. However, not only sources of sound were important, but also their level. People associate noise which is rather a rare phenomenon in nature with danger and it causes stress in their organism. Nowadays noise surrounds us from everywhere and has a negative influence not only on our health and the quality of work, but it also changes our

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offenders. Ordinance of the Minister of Police Ming Ti from 211 BC proclaimed: "Whoever dares to insult the lord, will not be pegged, beheaded or pilloried, but will be sentenced to the uninterrupted listening to pipes, beating drums and cries until he drops dead. It is because this is the most tiring death, that a human can bear. ...". The watchword "Salus per Silentium", which means "health from silence", is the motto of new treatment centers, which through a contemplation of landscape in silence, have been conducive to improve health. The program Campaign to Protect Rural England indicates the role of tranquility as the indicator of the type of landscape (Bernat, 2011).

perception of landscape and has an impact on social relationships. In ancient China, noise was used as a severe punishment for

1.2. Threat of noise pollution

The results of the analysis carried out in Oslo showed a significant relationship between noise nuisance at night and sleeping problems. Research also indicates the occurrence of psychosomatic disorders and mild psychological problems among people exposed to noise (Fyhri and Aasvang, 2010). Also, studies conducted in







the United States by Zaharna and Guilleminault (2010) show the negative impact of traffic noise on sleep guality and, consequently, formation of diseases and disorders of the immune, circulatory, nervous and endocrine systems. Exposure to noises louder than 120 dB for children and 140 dB for adults, or prolonged exposure to levels above 75 dB, can cause hearing impairment. Noise also influences social abilities: reduces the intelligibility of speech, reduces cognitive performance and increases aggressive behavior (WHO, 2002). Many publications describe the negative impact of ultrasound and infrasound on human health and show the need to protect against this threat (Pawlaczyk-Luszczynska et al., 2005; Bolin et al., 2011; Alimohammadi et al., 2013). In addition, noise can affect the behavior of wild animals (Francis et al., 2009; Barber et al., 2010). Studies show, that the exposure of animals to noise can lead to DNA damage, changes in gene expression and changes at the cellular level. This has an impact on the final effect in the neurological system. The European Environment Agency estimates that in the EU noise is linked to 43,000 hospital admissions, 900,000 cases of hypertension and up to 10,000 premature deaths per year (EEA, 2014). Social costs of road noise related to disease and premature death were estimated by the European Union for the amount of \in 40 billion (EC, 2011).

Under Polish law, since 2004 the noise level in residential areas during the day should not exceed 55 dB and at night 50 dB. These levels were set in accordance with the recommendations of the EEA (2010). The regulations in Poland changed in October 2012 and the permissible noise level for daytime is now 61 dB and 56 dB for night-time. The WHO report entitled Night Noise Guidelines for Europe (WHO, 2009) gives a clear recommendation that from the health point of view the calculations of night-time burden should start at 40 dB and that action planning should at least contain an aim to bring down the level below 55 dB. On the first of June 2011, the European Commission, based on the data provided by member states, announced the report on the implementation of the Directive 2002/49/EC, which shows the quality of acoustic environment in the EU and assesses the need for further actions of the EU to reduce noise in the environment (EC, 2011). These studies confirm that noise in the environment is a very serious threat to public health and that noise exposure in Europe is increasing. In 2011, about 40 million people living in the EU agglomerations are exposed to urban traffic noise during night-time with an intensity of more than 50 dB. Outside agglomerations, the same kind of noise threatens the health of more than 25 million people. In 2012, about 5 million residents of the largest Polish cities were exposed to noise exceeding 55 dB during the day and about 4 million to noise above 50 dB at night (Chief Inspectorate of Environmental Protection, 2013). It is estimated, that the main threat to the acoustic climate is traffic noise, especially from roads, while industrial noise is becoming less dangerous. Increased noise impacts associated with the development of air transport are mostly limited to areas around airports (Kotus, 2007). The recent WHO recommendations include the reduction of the permissible level of noise to 40 dB. It is justified by the fact, that in the current assessment of noise in the EU a significant part of the population is exposed to noise at lower levels, which probably also have harmful consequences for the health (WHO, 2011).

1.3. Noise as a motivation of residential migration

According to the questionnaire surveys conducted on the people moving out from Poznan (Beim and Tölle, 2008), the selection of the new specific location was primarily determined by environmental values where silence was recognized as the most important factor. Of all the participants in the survey, 82.7% pointed that out. The next factor – air pollution was mentioned by 79.4% of the respondents. The next factor which decided about the choice of location was the proximity of green areas, which was indicated by 77.7% of the respondents. After these environmental factors, the reasons for migration were: costs of the property's purchase, construction or rental. The vast majority (82%) reject the opportunity to return to live in Poznan. The consequence of the high rate of emigration from the city together with the delayed infrastructure development (sewage system, roads, kindergartens, etc.) is the uncontrolled spread of the buildings, which are littering rural landscape, causing the growing burden of roads and increasing noise. Therefore, it is a growing problem not only in cities but also outside them.

1.4. Ecosystem services linked to noise and their evaluation

Usually noise moderation is considered as a regulating ecosystem service. Alternatively, the sounds produced by ecosystems can be treated as a cultural service. Noise, as unwanted sound reduces the value of the ecosystem services and could be a convenient indicator of landscape/soundscape quality (UK National Ecosystem Assessment, 2011). Studies (DEFRA, 2009; Liu et al., 2013) confirm that the tranquility affects valuing scenery, as well as valuing fresh air and wildlife. Recreation and ecotourism are valuated among cultural ecosystem services most often, but esthetic and educational as well spiritual and symbolic services also play an important role (Hernández-Morcillo et al., 2013). Tranquility provides artistic experience and sensitizes to the beauty of nature. Many countries have introduced instruments for the protection of soundscapes and treat them as a tourist product. As studies show, both for the preferences of residential migrants (Beim and Tölle, 2008) and for the costs of dwelling rent (Baranzini et al., 2010), the possibility to hear sounds of nature is more important than e.g. scenic beauty. Although the soundscape is an intangible asset, the attempts of its evaluation have been increasing, usually by estimating the economic costs arising from exposure to noise (lost productivity, medical expenses, decrease in revenues from tourism and from real estate trade). As the noise level does not have a market value, its valuation is usually performed using the stated preference methods, mainly by the contingent valuation method (CVM) (Merchan et al., 2014). This approach is based on the willingness of people to pay for mitigating the negative effects of noise for both humans and the environment. The disadvantage of such methods is that they are based on hypothetical situations and do not necessarily reflect the real choices, when consumers are faced with trade-offs between money and environmental protection. Besides, the willingness to pay is linked to the prosperity of the respondents (Anderson et al., 2013). It is noted, that, for example, more affluent people are willing to pay for noise reduction, even when they do not feel the negative effects of its impact, and vice versa - sometimes people, who suffer from excessive noise exposure reply that they would not be able to pay for noise reduction (Kolstad, 2000). Another way to measure these benefits includes indirect methods based on revealed preferences. A frequently used method in this group is the travel costs method (Bergin and Price, 1994; Czajkowski et al., 2014). The hedonic pricing method (HPM) is most commonly used to estimate economic benefits or costs associated with environmental amenities, such as esthetic views or access to outdoor recreation areas (Sander and Haight, 2012). Sometimes quiet surroundings are treated as the part of environmental amenities (Borkowska et al., 2001), but often the influence of noise on property value is analyzed separately (Bateman et al., 2001). This approach, on the one hand, allows for finding how the value of the property depends on technical conditions and on the other hand, allows for assessing how much we are willing to pay for e.g. silence. The main problem associated with the revealed preference method is to find data that allows you to extract the environmental effect, while controlling other factors (Mahashabde Download English Version:

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