ABSTRACT OF A DOCTORAL DISSERTATION

Impact of surface deformation caused by hard coal mining on the value of land intended for development in the Upper Silesian Coal Basin

The aim of the research presented in this paper is to estimate the impact of surface subsidence of areas formed as a result of underground mining on the market value of undeveloped land intended for residential construction (excluding multifamily housing) in the years 2008-2017 in the Upper Silesian Coal Basin. The essence of the conducted research was to present in detail the development of prices of undeveloped land intended for construction purposes affected by mining activities and to compare the current prices of undeveloped properties in areas subject to long-term impact of underground mining to areas not subject to such mining activities. Based on the collected data, the paper also presents a forecast of these changes for the future.

The dissertation consists of an introduction, six substantive chapters and conclusions. The first chapter is a review of previous research based on the literature and it contains four subchapters. The first subchapter covers the issues of the impact of underground mining activities on land surface changes. The author reviewed theories of the prediction of mining deformations, as well as the issues of the impact of underground mining on the surface and its objects. The subchapter further discusses and presents the division of rock mass shakes, the origin and characteristics of deformation, hydrological transformations and classifications of mining areas. The conclusion of this subchapter focuses on the manners in which mining sites can be monitored. The author also discussed a number of contemporary methods for predicting surface deformation.

The second subchapter addresses issues relating to mining damage in terms of the social aspect. Mining damage is a significant social problem that affects a large part of the population living in mining areas. The chapter attempts to define mining damage as a problem with a significant social dimension. The contents presented in this subchapter allow one to conclude that mining damage can be fully identified with the definition of social problems. This subchapter also discusses the effects of mining activities, hard coal mining in the context of the

principles of sustainable development. At the end of the subchapter, the issue of mining damage in terms of the sense of responsibility of mining companies was brought closer.

The third subchapter deals with the real estate market. The issue of the market characteristics of real estate, which have a significant impact on the development of transaction prices, was discussed.

The fourth subchapter attempts to define landscape, discusses the importance of spatial order and the impact of landscape values on the development of property prices. The question of landscape aspects of price changes was addressed. Landscape aspects, or more precisely, the aesthetics of the surrounding space, have a significant impact on property values. Landscape components can significantly influence higher transaction prices achieved in the local property market. This subchapter also deals with the presentation of landscape values, addressing the dilemma of defining, specifying and analysing landscape boundaries. Selected landscape appraisal methods were also reviewed and described and an introductory discussion of the possibilities and characteristics of a land use map was held.

Chapter two discusses the research methodology. The process of conducting the research included two stages. The first one involved obtaining materials and extracting only the necessary information from them, as well as generating digital maps showing land subsidence, projected land deformation and average unit prices of residential undeveloped land. The second one involved analysis and interpretation of changes taking place in time and space, as well as determination of the impact of land surface transformation on prices for undeveloped land obtained on the local property market.

Chapter three describes the area covered by the research and its characteristics. The first part discusses the general characteristics of the Upper Silesian Coal Basin in terms of location, land use and geological structure. The second part of the third chapter focuses on the areas covered by the research in terms of location, geological structure, landforms, soil cover and land use.

Chapter four presents and interprets the impact of land subsidence as a result of hard coal mining activities on the price of land intended for development in the Upper Silesian Coal Basin. For each area covered by the research, a visual presentation and detailed analysis of the map of land subsidence, maps of average unit prices of residential undeveloped land and maps of the impact of land surface deformation related to mining exploitation on the price of land for development over the analysed years were made. Graphs showing the dependence of the average unit price of residential undeveloped land on land subsidence were also presented and interpreted. In the presented maps and charts, the relationship between land subsidence and the

price per 1 m2 of land property can be observed. Further underground hard coal mining is expected in the areas under consideration, which will contribute to further deformation of the land surface in the form of mining subsidence. An analysis of the map of projected land subsidence showed significant changes in the land surface.

Chapter five analysed the data. Data on land subsidence and average unit prices of undeveloped residential land were subjected to spatial analysis, which made it possible to determine and visualise the impact of land subsidence caused by mining on average transaction prices of land. The analysis of land subsidence maps of the regions under consideration showed areas unstable as a result of mining activities and land relief transformations. An analysis of the projected land subsidence maps showed significant changes that will occur in the relief for all areas under consideration. Between 2018 and 2040, the projected mining in the area in question could result in the formation of numerous subsidence basins. An analysis of the market data and price change trend for all areas covered by the research was carried out. The last subchapter analyses maps of average unit prices of undeveloped residential land for all areas covered by the research. The market characteristics of the properties were also presented. The impact of the dependence of land unit prices on land subsidence was analysed and interpreted.

Chapter six is devoted to assessing the impact of land cover and land use on the price of land intended for development. The main part of this chapter focuses on the presentation and detailed analysis of the landscape value map. The impact of land cover and land use on the price of land intended for development over the analysed years was discussed for all areas covered by the research. The initial assessment of landscape units concerned the location and the surface characterisation of land cover forms, which consisted of determining the area of the analysed landscape units. In the next step, the relationship between the average land price and the land cover form highlighted in the CORINE Land Cover database was determined. The analysis aims to answer the question of how landscape values influence the results of property appraisal.

This paper is the first study to present in detail the price development of undeveloped land intended for residential development affected by mining activities and subsidence. It is also the only study that compares the current prices of undeveloped real estate in areas subject to long-term impact of underground mining to areas not subject to such mining activities. Based on the collected data, the study presents a forecast of these changes for the future. The process of the mining of hard coal deposits causes significant spatial and aesthetic transformations in the landscape. The conducted analyses proved that there was a direct correlation between land subsidence and land prices. The paper presents directions for the management of heavily degraded and devastated post-mining areas that are subject to reclamation. The paper proves

that there are a number of negative aspects associated with active mining activities and points out that the process of reclamation and appropriate development of post-mining areas can significantly increase the value of the landscape.