

### **Description for the general public (in English)**

Global warming and climate change are at the top of the list of the most significant global concerns of the contemporary world. The factor causing the greenhouse effect and thus contributing to climate change to the greatest extent is greenhouse gas emissions, among which CO<sub>2</sub> constitutes their greatest share.

On the one hand, the reduction of CO<sub>2</sub> emissions seems an important global challenge nowadays, on the other hand, the issue of greenhouse gas emissions is strongly linked with countries' economic activity. Thus, a conflict between the need to reduce emissions and to maintain economic activity is unavoidable. In economic and environmental areas the phenomenon of decreasing carbon emissions and maintaining economic growth is called decoupling. So, decoupling economic growth from environmental pressures is crucial to global sustainable development.

The relations between CO<sub>2</sub> emissions, the crucial factor in global warming, and economic activity is a concern of both policymakers and scientists, especially those working within environmental economics. Policy debate, lasting for almost 30 years, has resulted in the Kyoto Protocol (1997) and the Paris Agreement (2015), which encourage countries to join global efforts aimed at reducing pollution. The number of research projects in this area is growing, however, most of them address local issues. The global aspects are inadequately, if at all, described in the subject literature. The proposed research project attempts to address these inefficiencies.

In the context of a discussion on the sustainable economic development strategy, three important questions should be posed. First, what is a general picture of decoupling CO<sub>2</sub> emissions from economic growth? Second, do the factors affecting changes in CO<sub>2</sub> emissions in the decoupling process play the same role in different countries? Third, what is the potential to reduce carbon emissions while maintaining economic growth in particular countries?

There are three main objectives of this research project. First, the assessment of the decoupling process of CO<sub>2</sub> emissions from economic growth. Second, the identification of factors affecting changes in CO<sub>2</sub> emissions in the decoupling process. Third, the evaluation of the potential to reduce CO<sub>2</sub> emissions maintaining economic growth in particular countries.

The project will cover a large sample of countries limited only by data availability. Countries in the study will differ in terms of their level of development, CO<sub>2</sub> emissions, energy policy goals and vulnerabilities to climate change. The project will consist of three main stages.

The first one will focus on the analysis of decoupling CO<sub>2</sub> emissions from economic growth for the detrended series using two approaches: time-varying parameter regression and Tapio decoupling method in rolling-windows. Next, on the basis of various economic, political and climate features, groups of similar countries will be identified, and, finally, it will be established what factors within economic, political and climate aspects determine decoupling. In the second stage factors affecting CO<sub>2</sub> emissions will be identified through two approaches: the LMDI model and the STIRPAT model. Given the heterogeneity of the analysed countries, a fixed effect panel quantile regression model will be used to investigate the effects of various factors on CO<sub>2</sub> emissions. Next, the countries will be clustered according to the factors obtained in the models. Finally, the groups of countries will be examined in terms of their economic, energy policy and climate features. The third stage will analyse carbon efficiency with the use of the stochastic frontier analysis (SFA). Both, a traditional framework, based on the production function, and a less formal specification, rarely used in studying carbon efficiency. Carbon efficiency of particular countries will be assessed in relation to their economic, political and climate features.

In general, a several novel dimensions can be distinguished in our project. Most of them are linked with the application of modern statistical and econometric techniques, which will provide new insights into the area of study. Moreover, we will refer to both types of measuring CO<sub>2</sub> emissions i.e. the production- and the consumption-based approaches. Finally, we intend to take into account the country's exposure to extreme climate conditions, as we believe that the impact of this factor on the countries' energy and climate policy is significant yet not discussed at all.

The expected impact of the results of the project on the development of science is as follows. The methodology applied in the project allows for presenting novel aspects of the studied phenomenon. Our use of index measuring the country's vulnerability to climate change is an important contribution. The project will consider several important factors, which have not been investigated for a country-level comparison. The results might turn out to be innovative and reveal hidden dimensions of the relationships studied.

This project is addressed to researchers working in the field of sustainable development, which investigates relationships between environmental protection, energy policy and economic growth. Importantly, this project can be of interest to policymakers, because it will provide an insight into the decoupling and factors directly affecting the decoupling process and CO<sub>2</sub> emissions. Finally, our results will be potentially beneficial in the area of increasing social awareness and shaping desirable attitudes among consumers.