Analysis of mechanisms of economic evolution
in the context of environmental protection and limited resources

One of the most important subjects of the evolutionary approach in economics is the analysis of mechanisms that could appear within evolution of the economy. In the last years, the importance of awareness of environmental threats and the significance of information and knowledge for evolution of the economy are emphasized. At the same time, a complex analysis of the role of information, as well as the role of knowledge on environmental awareness of agents and decision makers in evolution of the economy, has not been presented so far. In this context, the aim of the research is:

(1) to analyse the role of the environment-friendly activity of producers and consumers for economic evolution in the conceptual axiomatic formalistic approach,

(2) to model eco-mechanisms of evolution of the economy in the context of limits of resources,

(3) to examine the roles of information and knowledge in evolution of the economy with limited resources.

In the first research area we want to highlight and analyze internal factors in the pro-ecological engagement of producers and consumers based on their awareness of limited resources. Consequently, the process of eco-development we will construct allows eco-innovative changes to accelerate and intensify but not to radically affect resources. In particular, it will be proved that the pro-ecological behaviours of consumers and producers play an important role as co-engine of resource-constrained development. In the end, formal theorems will be formulated to indicate sufficient conditions to guarantee resource-constrained development in terms of the pro-ecological activities of market agents in the given model. Results will show that consumers with environmental-friendly preferences and producers who realize pro-ecological production plans may shape technological trajectories to improve the diffusion of eco-innovations and may reduce the negative environmental impacts of innovative changes.

The aim of mechanism design theory is to describe, by the use of mathematical tools, analyse, compare and potentially regulate structures and procedures in order to achieve desired goals under given initial conditions. We will consider mathematical models of the economy in which the relationships between quantities of goods and quantities of the productive factors used to produce them will be examined under the assumption that heterogeneous agents spend their time observing local organization environments, transmitting messages, computing, storing and retrieving information. We will focus on modelling three kinds of processes: eliminating harmful commodities or technologies from production processes, introducing new commodities by the use of eco-technologies as well as reducing the quantities of resources using within production processes. Some optimal mechanisms will be also presented.

In third part we aim at modelling a space of information understood as a set of all feasible signals sent by economic agents and analyzing its role in economic evolution. The signals are connected with agents' activities on the market and they are noticed, recognized and analyzed by other economic agents. In this project, the case of full or partial access to information about market activities will be taken into account. We will determine, among others, links between information and the outcomes of the eco-innovative processes and show how partial access to information influence on the qualitative properties of the mechanisms under study. In the models to be presented, two kinds of agents, with full or partial knowledge of the harmfulness of some commodities or technologies, will be considered. Diversification of agents with respect to the level of knowledge enables us to analyze how knowledge influence on the formulas of outcomes, the size of the set of outcomes, as well as qualitative properties of the presented eco-innovative mechanisms.

The core of the project is the pure theoretical analysis but some results of statistical analysis will be also presented.

To analyse the objects and processes under study, the axiomatic methods in economies, methods of mathematical analysis, the functional analysis, the difference equations as well as modern methods of multivariate statistical analysis, among others, will be used in this project. As a result we obtain a coherent study on contemporary driving forces of economic evolution, on the other hand, a unified and coherent description of a class of innovative mechanisms which could appear within evolution of the economy and which result in the outcomes beneficial for the environment.

The proposed analysis is interdisciplinary in its nature and it links the areas of the evolutionary economics and the mechanism design theory with the statistical methods of data analysis. The implementation of the project's objectives is a part of research on activities aimed at improving the condition of the natural environment and saving resources.