MODELING THE IMPACT OF POLLUTION ON THE SOCIAL COMPONENT OF ECONOMIC DEVELOPMENT

Ganna Kharlamova, Vladimir Nagornyj
Taras Shevchenko National University of Kyiv, Kyiv, Ukraine

Humanity entered the third millennium with a burden of complex economic, political, ethnic, social and environmental problems. Namely environmental issues in its significance are unique in history. Thus, the objective prerequisites are created for the study and subsequent implementation of knowledge about different approaches to preserving the quality of the environment at local, regional and global levels.

The growing scale of economic activity results in its negative effects on nature, the threat of deterioration environment for human existence arises even for the normal functioning of the economy. The balance of natural processes is violated; the environment loses its ability for self-reproduction. In such situation the environmental assessment becomes necessary for a long existence of technological civilization, and the importance of modeling and forecasting ecological and economic processes becomes a burning issue.

In the practical part of the research, it has been examined the following statistics: emissions, energy consumption, water pollution, mortality, health expenditure, life expectancy, the prevalence of HIV, investment in fixed assets. The following groups of countries have been considered:

- Group 1 - Baltic countries (Lithuania, Latvia, Estonia);
- Group 2 - Ukraine, Russia.

Designations:

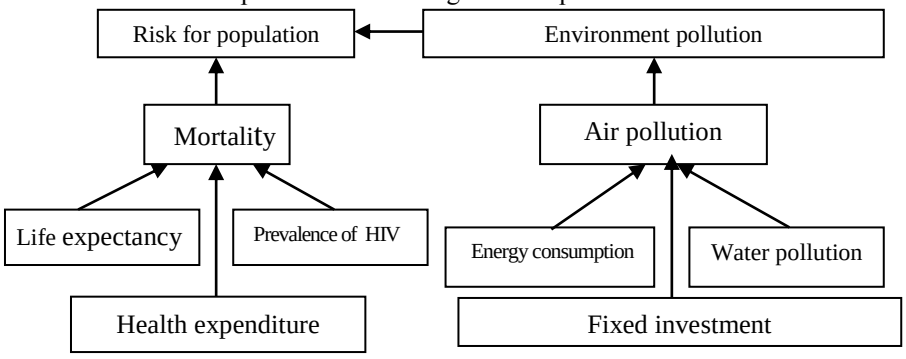
- AP - air pollution (CO_2 CT);
- EPC -electric power consumption (kWh per capita);
- EU - energy use (kg of fuel equivalent per person);
- WP - water pollution (kg per day per worker);
- DR - death rate (deaths per 1000 people);
- HE - health expenditure (% of GDP);
- LE - life expectancy (years);
- HIV - HIV prevalence (% of population aged 15-49 years);
- FI - fixed investment (% of GDP).

Links between these parameters are described by the next model:

$$\begin{cases} AP_{i,t} = \beta_{10} + \beta_{11} \cdot EPC_{i,t} + \beta_{12} \cdot EU_{i,t} + \beta_{13} \cdot WP_{i,t} + \beta_{14} \cdot FI_{i,t} + \varepsilon_{i,t} \\ DR_{i,t} = \beta_{10} + \beta_{11} \cdot HE_{i,t} + \beta_{12} \cdot LE_{i,t} + \beta_{13} \cdot HIV_{i,t} + \beta_{14} \cdot AP_{i,t} + \varepsilon_{i,t} \end{cases}$$

The analyzed model is represented by two-dimensional model, where in the second equation as an independent variable the dependent variable forming the first equation is presented. The model with panel data has been chosen to build the multivariable linear regression model, because such type of models are more robust to missing variables, measurement errors and the presence of endogenous variables among the repressors.

So we attempt to model following links' map:



During the simulation each equation was tested on adequacy, factors' importance; as well RESET, Hausman, Dickey-Fuller, White, Durbin-Watson, Johansen-Fisher criteria were tested. Estimates of regression coefficients were calculated via different methods:

1) Weighted least squares method was used to overcome heteroscedasticity;

2) Generalized least squares method was employed to overcome the autocorrelation;

3) Ordinary least squares method has been implemented in general case.

As a result we have such system of equations:

1. Modeling the impact of pollution on the social component of economic development of the Baltic countries:

1.1) $AP_{1,t} = 41159{,}3 + 0{,}36EPC_{1,t} - 140117{,}7WP_{1,t} - 43{,}3FI_{1,t} + \varepsilon_{1,t}$

1.2) $DR_{1,t} = 66{,}98 - 0{,}22HE_{1,t-1} - 0{,}77LE_{1,t} + 1{,}45HIV_{1,t} - 0{,}0001AP_{1,t} + \varepsilon_{1,t}$

2. Modeling the impact of pollution on the social component of economic development of Ukraine and Russia:

2.1) $AP_{2,t} = 3855592{,}7 + 355{,}4EPC_{2,t} - 22547192WP_{2,t} - 12552{,}6FI_{2,t} + \varepsilon_{2,t}$

2.2) $DR_{2,t} = 26{,}7 + 0{,}7DR_{2,t-1} - 0{,}2HE_{2,t} - 0{,}3LE_{2,t} + 0{,}8HIV_{2,t} + 0{,}0001AP_{2,t} + \varepsilon_{2,t}$

Analyzing the impact of elasticity coefficients in the first model, we can conclude that the environmental situation in the Baltic states, Ukraine and Russia mostly is influenced by water pollution, then – electricity usage, and in the last way - investment in fixed assets.

According to the results of the second model - the most influential index on the social component of the Baltic countries is the life expectancy, and ecological situation is at the second place, according to the measure of impact. As for Ukraine and Russia, the most influential index is the index of environmental pollution, and life expectancy follows it.

Differences in factors of influence can be explained by differences in the situation in the regions as regards improving the environmental situation and the policy of sustaining healthy lifestyles.