# IS ECONOMIC GROWTH A CAUSE OR CURE FOR THE ENVIRONMENTAL DEGRADATION: THE CASE OF ENVIRONMENTAL KUZNETS CURVE

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The relationship between economic growth and pollution has been a focus of research by economists for many years. There are two basic competing views with respect to this relationship: the first one states that economic growth is harmful to the environment due to ineffective use of recourses, while the second one states that technological process and economic growth improve environmental quality.

In 1995, Grossman and Krueger (1995) on the basis of cross-country analysis introduced the inverted *U-shape* relationship between pollution and per capita income. Due to the form of the relationship the curve was named the Environmental Kuznets Curve (EKC), after Simon Kuznets, who in 1955 showed that at the early stages of a country's development the gap between poor and rich increases, while when the country becomes wealthier the inequality gap decreases.

*The main objective of this study is the estimation of the functional form of the EKC for different air pollutants in Ukraine.* We want to see whether or not Ukraine follows developed and developing countries that do exhibit the EKC relationship.

The data set used in this study consists of three blocks: (i) income block, (ii) pollution block, and (ii) meteorological block.

*The Income block* includes– data on a city level for 50 big Ukrainian cities. Basic variables in the income block are average annual wages in regions and per capita income. Data for per-capita income and wages is taken from the Ukrainian Statistical Year Books.

*The pollution block* consists of *concentrations.* Concentrations are measured in mg/m$^3$ The data set includes concentrations of such pollutants as *$CO_2$, $NO_2$, $SO_2$, dust and IAP (index of air pollution).*

*The meteorological block* is presented by such indicators as the number of days in a year with *smog, precipitations, winds, and annual average temperature*. Based on these indicators, a vector of climate variables was constructed which includes: percentage of days with smog, winds, precipitation during a year; average temperature.

Basic model that we are going to test is taken from Egli (2004), who tested the EKC hypothesis for Germany using pooled data. Egli (2004) found a reduced form model with only squared terms for income that underlies the inverted U-shape relationship. He used the following specification:

$$E_t = \beta_0 + \beta_1 Y_t + \beta_2 Y_t^2 + \beta_3 Y^3{}_t + \beta_4 S_t + \beta_5 I_t + \beta_6 D_t + \varepsilon_t \quad (1)$$

where $Y$ stands for per capita income, $S$ – industry's share in GDP, $I$ - sum of imports and exports from pollution intensive production relative to GDP, $D$ is the reunification dummy for Germany.

In our model, the pollution-income relationship is based on theory using available data. Due to the fact that we have a panel data for 50 big Ukrainian cities, the model (1) will be changed slightly and expanded.

The model that we are estimating in our study is:

$$E_{it} = \beta_0 + \beta_1 Y_{it} + \beta_2 Y_2^2{}_{it} + \beta_3 Y^3{}_{it} + \beta_4 T_{it} + \beta_5 W_{it} + \beta_6 R_{it} + \beta_7 S_{it} + \varepsilon_{it} \qquad (2)$$

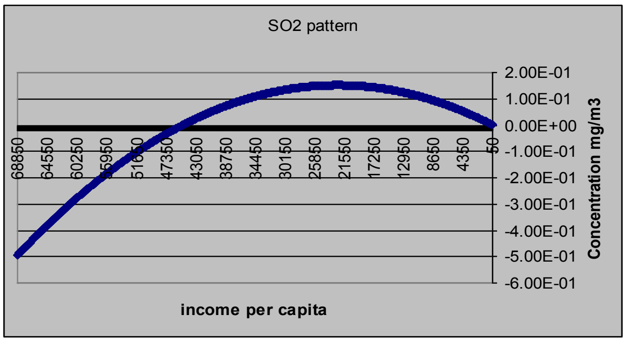
where $E_{it}$ stands for pollution in a city $i$ in year $t$, $Y$ stands for per capita income in each particular city, $T$ - is average annual temperature in each city $i$, $W$ – is the percentage of days in the year with wind in each particular city, $R$ - is the percentage of days in the year with precipitation in the city, $S$ – is the percentage of days in the year with smog in each city. In general, model (2) is restricted in a sense that we have a single intercept for all cities. According to that assumption, within one country the pollution would be the same if all economic and climate factors were equal. That assumption can be overcome by incorporating dummy variables for all but one city, which is a control unit.

In the case when there is strong link between income and climate variables, equation (2) will be affected by multi-collinearity due to correlation of income with other variables. The relationship between pollution and income based on instrumental variable approach can be specified as follows

$$\ln SO2_{it} = \alpha_0 + \alpha_1 \ln \hat{Y}_{it} + \alpha_2 (\ln \hat{Y}_{it})^2 + \alpha_3 \ln W_{it} + \alpha_4 \ln R_{it} + \alpha_5 \ln S_{it} + e_{it} \quad (3)$$

In which $\hat{Y}_{it}$ is the predicted value of capital for each particular city.

Looking at the graph 1, it is seen that income and income squared are both significant, and indeed represent the inverted U-shape relationship.




Graph 1 – The pollution – income relationship (case of $SO_2$)

The key point that we may conclude from the table is that according to our predictions the concentration of $SO_2$ should start to decline in Ukraine, when the per-capita income will be at level of about UAN22000. The obtained results are not in contradiction with the previous works of Western scientist, and we say that Ukraine has its own EKC (at least for $SO_2$). The rest of the pollutants did not show the inverted U-shape relationship, however we assume that it could be due to the small period of observation, and low volatility in data, more econometric analysis should be done in that spree.