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AN ESTIMATION OF SELF-ORGANIZATION EFFECTS IN REGIONAL ENVIRONMENTAL MONITORING SYSTEMS

Khodyko D. I., Candidate of Economic Sc.
Ivan Franko National University of Lviv, Ukraine

The concept of self-organization can be meaningfully applied to regional economies and administrations, which stems from the regions' treatment as open socioenvironmental systems of a complex ontology [1]. Specifically, to test for presence of self-organization effects we focus on regional pollution monitoring for air and ground. The proposed simple framework contrasts two modeling approaches to the impact of pollutants' health safety class upon their coverage in regional environmental monitoring programs, namely the treatment of the impact as exogeneous or endogeneous. While confirming the superior validity of either approach may have practical implications, significance of effects in both specifications would testify for occurrence of regional self-organized processes in response to changes in macroeconomic policy environment.

Two logistic regression specifications with random effects were built with the dependent binary response Observation variable reflecting the coverage of a specific pollutant by a particular regional monitoring program for a given year. Both models included categorical factors, Nation and Region, to capture the corresponding level effects, as well as the monitoring agencies' central government budget figures, used to approximate monitoring activities funding. The latter Budget variable was included as a continuous covariate. In the first model, the exogeneous impact of pollutants' safety class (according to Ukrainian State Standard 12.1.007) was modeled by inclusion of categorical Class factor as a main effect. In the second model, the endogeneous impact was modeled by inclusion of ordinal Class covariate, and the Region-Class interaction effect was estimated.

The data set covered the 2008-2012 monitoring programs for Lvivska [2] and Zakarpatska [3] regions of Ukraine, Podkarpackie and Malopolskie voivodships of Poland [5], six air (carbon oxide, formaldehyde, ammonia, phenol, chlorine, lead) and two ground pollutants

(cadmium, oil products). The budget figures for the actual monitoring agencies, the Ukrainian State Sanitary Control budgetary program and the Polish Chief Inspectorate of Environmental Protection, were obtained from the respective legislative sources [4][6].

We find that, for both specifications, the model effects are generally significant with $p < 0.001$, which arguably validates the self-organization concept. The second model captures various within-region effects of pollutants' class upon their monitoring coverage, as well as sensitivities towards central budgeting changes. The regional systems' ability to adapt for macro policy signals (captured by Region-Nation-Budget effects), as well as positive or negative environmental impact of such adaptation (captured by Region-Class effects) are therefore subject to comparative statistical estimation.

The following table 1 provides effects test results for both specifications. For the second model, some of the parameter estimates are additionally shown.

Table 1

Estimation of logistic regression models with random effects

	Wald Chi-Square	df	Sig.
Class	16,104	2	,000
Nation * Budget	10,325	2	,006
Region * Nation * Budget	1,443	1	,230

Dependent Variable: Observation

Model: (Intercept), Class, Nation * Budget, Region * Nation * Budget

	Wald Chi-Square	df	Sig.
Region * Class	17,870	4	,001
Nation * Budget	5,947	2	,051
Region * Nation * Budget	7,819	2	,020

Dependent Variable: Observation

Model: (Intercept), Region*Class, Nation*Budget, Region*Nation*Budget

Parameter	B	Std. Error	Wald χ^2	df	Sig.
[Reg=Lviv] * Class	1,356	,4859	7,788	1	,005
[Reg=Malopol] * Class	-,559	,2991	3,493	1	,062
[Reg=Podkarp] * Class	-,708	,2964	5,705	1	,017
[Reg=L]*[Nat=UA]*Budg	-2,933E-6	1,1001E-6	7,107	1	,008

Source: adapted from SPSS 16.0 output

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