Pollutant Emission Forecast As an Inverse Stochastic Problem: a Non-extensive Entropy Econometrics Approach

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Summary

This paper proposes a non-extensive entropy related approach to predict cross Polish industrial sectors and regions pollutant emissions on a basis of knowledge limited to the total aggregated greenhouse emissions at the regional and sectorial level. In such a case, we more plausibly have to deal with an inverse stochastic problem, which solving thereby classical statistical tools remains less appropriated.

This document considers that non-extensive entropy should remain, even in the case of low frequency series, a precious device for econometric modeling since outputs provided by the Gibbs-Shannon entropy approach correspond to the Tsallis entropy limiting case of the Tsallis q-parameter equal unity. Then, we set up a q-*Tsallis-Kullback-Leibler entropy* criterion function with *a priori* consistency constraints –including normal conditions. To increase minimize error estimators, obtained outputs in the first step are used in the next step as a priori information. In the next iterative steps, we combine the *q-generalized Kullback-Leibler cross-entropy as a criterion function* with the environmental Kuznets econometrics model properties to set up additional restrictions.

As in the case of Shannon-Gibbs based entropy models, we found the estimated estimator through Tsallis entropy formalism still belonging to the family of Stein estimators, meaning that smaller probabilities are shrunk and higher probabilities dominate in space of solutions. Fortunately enough, adding more pertinent a priori information in the model(in the form of model restrictions) will enhance parameter precision and then allow for recovering the influence of smaller events. The q-Tsallis-Kullback-Leibler information-related inferential statistical indices are computed in accordance with estimator properties.

On empirical grounds, preliminary outputs confirm that more polluted Polish regions generally display model-generated higher indices of pollution for corresponding industrial sector. In spite of q-Tsallis parameter very close to unity, this Tsallis related approach reflects higher stability for parameter computation in comparison with Shannon-Gibbs entropy econometrics technique.