Analysis of socioeconomic indicators in the United States, Brazil, and other Latin American countries using econophysics techniques

Leonardo Rossato[1], José Roberto Iglesias[1], Sebastián Gonçalves[1]

[1] Instituto de Física, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brasil

Abstract: Econophysics utilizes statistical mechanics and physical techniques to tackle socioeconomic challenges and explore data analysis solutions. Unlike traditional econometrics, which primarily relies on linear regression methods, econophysics employs microscopic models such as gas-type and agent-based models, and incorporates graph theory when relevant. In this study, we adopt a heterogeneous approach to examine the relationships among socioeconomic indicators of municipalities in Brazil and the Americas, focusing on identifying emergent patterns. The research is conducted in three stages: initially, an in-depth analysis and correlation search are performed using databases from renowned institutions in each country. Subsequently, graphical representations are constructed to assist in visualizing patterns within the data. Finally, the data is transformed into graphs, facilitating comparisons and enhancing the understanding of emergent patterns. Our findings reveal significant relationships between indicators in Brazil, exemplified by a logarithmic relationship between the Municipal Human Development Index (IDHM) and population size, particularly population density, above a critical population density. These relationships are examined across various scales, from national to macro-regions (Northeast, North, Midwest, Southeast, and South) and state levels. Additionally, we identify correlation coefficients at each scale and conduct robustness analyses of these coefficients using various techniques. We extend this procedure to other countries in the Americas, emphasizing common indicators to facilitate comparative analyses. In the final stage, we transform the proportion functions derived from the second stage into graphs using a technique from astrophysics called "Gravitational Clustering." With these new representations, we establish a criterion for detecting and comparing the critical coefficient values from the second stage.

References

[1] A. Gomez Jonatan, B. Dipankar D., and C. Olfa N., A New Gravitational Clustering Algorithm (2003), DOI: https://doi.org/10.1137/1.9781611972733.8.

Analysis of socioeconomic indicators in the United States, Brazil, and other Latin American countries using econophysics techniques, DOI: https://doi.org/10.1140/epjb/s10051-024-00766-5. Published by: Springer, EPJ-B.

Type

ORAL