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Spatial heterogeneity in nonparametric efficiency: an application to Italian hospitals

The efficiency analysis of health care services has been widely developed and it has been subject to several technical refinements. One of the problems of the analysis, specifically in the nonparametric frontier framework, is that the spatial dependence among units is often neglected and/or attributed only to the stochastic error term.

The objective of the paper is the assessment of the technical efficiency of Italian hospitals, taking into account how the variability of their performance is influenced by some relevant features of the local context in which they operate. Differently from the conditional efficiency approach we do not directly assess the impact of contextual variables in the estimation, since this approach, as highlighted by several authors, tends to be ineffective in local contexts characterized by a “global” spatial effect, where the role of intangible aspects, often statistically and economically difficult to be captured, is particularly relevant. One of the main implications for the analysis is that the local context is not to be defined by imposing ex-ante geographical or administrative borders, but it will be the outcome of a clustering process based both on spatial and health-relevant contextual factors proximity. Efficiency will therefore be estimated for the different hospitals in the different clusters.

Analytical regionalization methods (also known as spatially constrained clustering, Murtagh, 1985; Duque et al., 2007) have been tested in order to cluster a large number of geographic points into a smaller number of regions based on similarities. More precisely, the Skater algorithm has been used in order to identify homogeneous areas of demand and to condition the efficiency estimates on the basis of whether these clusters belong to the same group. On the basis of a set of health-relevant conditional environmental variables (population density, mortality, income, etc.) the minimum spanning tree has been built and, after that, a partition of homogeneous and contiguous territorial zones has been identified. After identifying homogeneous clusters of demand, the nonparametric efficiency estimates have been carried out; more specifically, the estimates have been repeated twice: in a first step, the DEA and the more robust Order-m measures have been compared in order to exclude hospitals with out-of-scale input/output data.

The average regional order-m scores are then compared with the punctual ones and the average regional order-m scores with the conditional ones; the idea is that conditional scores are more dissimilar to regional scores than non-conditional scores in terms of spatial distribution. A Syrjala test (Syrjala, 1996) is carried out for the difference between the spatial distributions of the different order-m and conditional scores. An evaluation of how our results change with the variation of the clustering parameter is also carried out., through the estimation of different distributions of conditioned efficiency.