On the Stationarity of Heterogeneity in Production Technology

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ABSTRACT. An important assumption for the application and interpretation of frontier analysis is the homogeneity of the reference set, meaning that all observations belong to the same production possibility set. In particular the use of frontier analysis to identify firm-specific efficiency potentials in economic regulation (Bogetoft, 1997, Agrell et al., 2005) requires careful validation of this condition. Recent work (e.g. Cullman, 2012; Agrell, Farsi, Filippini and Koller, 2013; Llorca, Orea and Pollitt, 2014) has applied latent class (LC) models to identify heterogeneous technologies for energy network operations. LC endogenously defines a finite set of separate cost functions, each of which emanating from an internally homogenous technology with a well-defined reference set. In several instances, the interpretations of the subsets have revealed meaningful information for the overall assessment. However, we argue that the applicability of the approach should be subject to two additional criteria: First, the definition of a heterogeneous technology should be time-invariant. Thus, in a panel setting, the partitioning of the reference set should be stationary and not transient. Second, heterogeneity in technology by subset should be distinguished from point-wise heterogeneity, identified by outlier detection techniques (super efficiency, order-m, et c.). Each presence of an outlier in itself only signifies that the specific point does not belong to the (single) reference set; there is no assumption of a complete partitioning of the reference set, but rather a reduction. On the other hand, the LC presupposes that the partitioning is done onto a reference set already clear of such outliers. Although intuitively acceptable and economically sound, the two assumptions are not automatically fulfilled in a LC model. We show for the case of panel data for Swedish electricity distributors that the LC classes are both sensitive to functional forms, presence of outliers and environmental variables. Furthermore, the LC classes are shown to be transient, violating the first condition for technology detection. We contrast our parametric results with the outlier detector methods and find a relationship between identified outliers and the elements of smaller residual classes. The work is important to clarify the potential role and method for detecting heterogeneous technologies in e.g. incentive regulation models where frontier analysis is used.

KEYWORDS

Frontier analysis, cost functions, latent class models, SFA, efficiency analysis

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