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Analyzing Sectorial and Regional Heterogeneity Effects in Agricultural Efficiency: A Mixed Model Approach

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Abstract

Technical and allocative efficiency of farm households has been widely studied in the context of panel data. While these techniques account for the estimation of efficiency in different frameworks, they do not investigate the latent heterogeneity at the sector level and at the regional level; an accurate analysis of the heterogeneity at the regional and sector level, as the one proposed here using mixed models, might, for instance, reflect differences in policy impacts, in technological progress, or even knowledge of the farmer at the regional or sector level. A common approach in this extent is to define farm types and analyse them using a consistent methodology, the estimation of a production function per sector. On the other hand, regional heterogeneity is often accommodated by adding regional categorical variables as a set of dummy regressors in the estimation.

A more general framework which is capable of accommodating these sources of heterogeneity in a flexible way is the mixed model approach. In the existing literature, this framework has been introduced in several different ways. First, by defining a second level error as an indicator of the firm's efficiency rate. Another approach, with the aim of relaxing the distributional assumptions, allows for time-varying efficiency levels with heterogeneity in slopes and intercepts for individual firms.

Our data allow classifying the farms according to agricultural subsectors and regional location, on the basis of a rotating panel data for 5 years (2003–2005) from the Farm Business Survey in The United Kingdom. Five types of farms to account for sector heterogeneity were defined; the data also allow us to identify the county to account for regional heterogeneity. Although our data come from the UK, the mixed model approach developed here will be of great potential for similar applications in developing countries, since sector and regional heterogeneity might be a major concern in this setting.

We compare the estimation results of several mixed models approaches like the one described before with the conventional stochastic frontier procedure. Estimations show similarities in coefficient and efficiencies estimations; on the other hand, variation between sectors and regions seem to have strong magnitude.

Keywords: Efficiency analysis, linear mixed models, stochastic frontier, unobserved heterogeneity