

Imposing Strict Positivity in Productivity Analysis: A Critical Review with Application to Stochastic Frontier Ecoefficiency Methodology

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Abstract

Productivity analysis plays a pivotal role in evaluating the performance of various economic entities, especially in the context of sustainable development. Since productivity measures are based on the notion of output-input ratios, non-positive values of inputs and outputs are not permissible. Overtime, various approaches to the imposition of the strict positivity assumption have emerged. However, there are no clear guidelines on the choice of different methods of handling this econometric problem under various circumstances. This paper provides an empirical review of the strict positivity assumption as it applies to productivity analysis, specifically focusing on its application to stochastic frontier framework. We examine the existing lines of approaches to handling zero values of inputs and outputs. Additionally, we empirically present a comprehensive case study using a real-world dataset together with Monte Carlo simulations to demonstrate the implications of various approaches in eco-efficiency stochastic frontier models. Finally, on the basis of our findings, we provide recommendations for future research and practical applications.

Keywords: Zero observations; Productivity analysis; Stochastic frontier; Eco-efficiency; Inverse hyperbolic sine; Dummy approach

1 Introduction

A key assumption of the SFA models is that all input and output variables are strictly positive. Essentially, this nonnegativity assumption implies that the value of the deterministic kernel, $f(x)$, is a finite, non-negative, and real number Coelli (2005). However, in applied research, it is not uncommon to encounter scenarios where decision-making units (DMUs) naturally apply zero units of inputs. For instance, in developing countries, a significant proportion of farmers do not apply pesticides. As a result, cases of zero inputs in productivity data may be inevitable. What is more, it is not guaranteed that applying inputs will result into positive outputs.

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