Productivity growth of wastewater treatment plants - accounting for environmental impacts : a Malmquist-Luenberger index approach

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Abstract

As the number of wastewater treatment plants (WWTPs) has increased, the economic considerations associated with their management have become more relevant. Measuring the productivity of WWTPs allows the best practice to be identified and resource use to be optimized. Previous studies assessing the productivity change of WWTPs have ignored undesirable outputs; thus, wastewater treatment was considered to be free of environmental impacts. To overcome this limitation and for the first time, we assessed the productivity growth of a sample of Spanish WWTPs, while also accounting for the emission of greenhouse gases and sludge production. The Malmquist-Luenberger productivity index (MLPI) and its components, the efficiency and technological changes, were estimated. To explore the role of environmental impacts in the measurement of the productivity growth of WWTPs, the MLPI was contrasted with the conventional measurement of productivity change: namely, the Malmquist productivity index (MPI). The omission of undesirable outputs led to an underestimation of the productivity growth, with statistically significant differences between the MLPI and MPI results. The comparison of the MPI and MLPI illustrated that WWTP operators and water agencies have internalized some good environmental practices into their production process costs..

Keywords

Malmquist-Luenberger productivity index, Wastewater treatment, Undesirable outputs, Greenhouse gases, Data envelopment analysis, Directional distance function.