

THESSALONIKI 2021 Conference

Productivity change of Chilean municipalities on municipal waste services: A Luenberger Productivity Indicator approach

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Keywords: Waste management, Productivity change, Malmquist Productivity Index (MPI), Luenberger Productivity Indicator (LPI), Municipal solid waste (MSW)

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Abstract

The collection of municipal solid waste (MSW) is a public service that impacts the environment and public health. The generation of MSW has increased significantly in the last decade. Therefore international institutions such as the United Nations and the European Union are promoting the recycling and reuse of MSW and being part of the Sustainable Development Goals 2030. This increase in the volume of MSW has marked consequences not only from an environmental point of view but also from an economic point of view. For this reason, several studies have evaluated the performance of European municipalities in the provision of MSW services. However, at the international level, there is still very little literature regarding evaluating the change in productivity in the field of waste, mostly there are studies applied in the area of water (Maziotis et al., 2017; Molinos-Senante et al., 2016), for the Chile's case, there is no previous studies related to the evaluation of productivity change of municipalities in the collection and treatment of their MSW, which is the main objective of this work.

As a concept, productivity change is defined as the relationship between the results obtained and the resources used in their production over time (Molinos-Senante et al., 2016), that is, it is a dynamic evaluation (Simões et al., 2012). By quantifying productivity over time, it can be determined whether municipalities' performance has improved or worsened in a given period of time, which for this study will be carried out between the years 2014 and 2018. The Chilean databases that were used as tools for obtaining the required statistical information are: SINADER (National System for the Declaration of Waste), SINIM (National System of Municipal Information) and the 2017 Census.

From the methodological point of view and regarding this topic, the literature is very limited, only (Simoes et al., 2012; Pérez-López et al., 2018) evaluated the change in municipalities' productivity in the provision of MSW services using the Malmquist Productivity Index (MPI). However, this index has two significant drawbacks: i) it is necessary to choose between an entry orientation or an exit orientation (Cook et al., 2010) and; ii) MPI relates the efficiency change (ECH) and the technical change (TCH) through multiplication (Cook et al., 2010). To overcome these disadvantages, there is an alternative indicator, the Luenberger Productivity Indicator (LPI), which has been shown to have significant advantages over MPI: i) the LPI relates ECH and TCH through addition; ii) can simultaneously concentrate on increasing outputs and decreasing inputs (Boussemart et al., 2003) showed that the MPI overestimates the change in productivity unlike the LPI, concluding that the LPI is higher than the MPI. Thus, this research is interesting to analyze since within the framework of MSW services, and there are no previous studies that evaluate the change in productivity using the LPI methodology.

Finally, this work's conclusions will be an important contribution to the literature. This information will be relevant to support public policies since it provides information to promote selective collection and recycling in municipalities both internationally and at the application level empirical study of this work, in Chile.

References

- Boussemart J-P, Briec W, Kerstens K, Poutineau J-C (2003). Luenberger and Malmquist productivity indices: theoretical comparisons and empirical illustration. *Bull Econ Res* 55(4):391–405. <https://doi.org/10.1111/1467-8586.00183>
- Cook, W. D., Zhu, J., Bi, G., & Yang, F. (2010). Network DEA: Additive efficiency decomposition. *European Journal of Operational Research*, 207(2), 1122–1129. <https://doi.org/10.1016/j.ejor.2010.05.006>
- Ministerio del Medio Ambiente, Chile. (2018). Fourth Report of the State of the Environment
- Maziotis, M., Molinos-Senante, M., Sala-Garrido, R. (2017). Assessing the Impact of Quality of Service on the Productivity of Water Industry: a Malmquist-Luenberger Approach for England and Wales. *Water Resour. Manage.* 31 2407–2427. DOI 10.1007/s11269-016-1395-6
- Molinos-Senante, M., Hernández-Sancho, F., Mocholí-Arce, M., Sala-Garrido, R. (2016). Productivity growth of wastewater treatment plants – accounting for environmental impacts: a Malmquist-Luenberger index approach. *Urban Water Journal*. 13, 5, 476–485
- Pérez-López, G., Prior, D., & Zafra-Gómez, J. L. (2018). Temporal scale efficiency in DEA panel data estimations. An application to the solid waste disposal service in Spain. *Omega (United Kingdom)*, 76, 18–27. <https://doi.org/10.1016/j.omega.2017.03.005>
- Simões, P., Cruz, N. F., & Marques, R. C. (2012). The performance of private partners in the waste sector. *Journal of Cleaner Production*, 29–30, 214–221. <https://doi.org/10.1016/j.jclepro.2012.01.027>