



Assessing factors that influence waste management financial sustainability



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ABSTRACT

This article examines the financial sustainability of waste management activities to understand whether and how choices oriented toward environmental protection and contextual factors influence waste management companies' revenues and costs, which, in turn, affect their financial sustainability and, thus, their ongoing viability.

To achieve this purpose, a three-year empirical analysis on 880 Italian municipalities was conducted. Financial sustainability was evaluated with reference to waste management companies working in these territories, and a set of quantitative and qualitative data was considered to investigate possible influencing factors.

The results show that separate waste collection may positively influence companies' financial performance, while municipalities' territorial extension negatively impacts profitability. Lastly, there is no evidence of a relationship between companies' financial sustainability and the potential presence of waste disposal plants or the geographical areas in which they operate. For the analyzed companies, thus, it seems that it would be more convenient to expand business by boosting separate waste collection activities than by enlarging the territories served.

These findings can support firms' decisions regarding environmental and financial issues, both of which are crucial for long-term sustainability. It can also help policy makers detect appropriate tools to support companies in implementing European Union waste management targets.

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1. Introduction

The collection and disposal of municipal solid waste (MSW) is a strategic issue for countries around the world, given the enormous increase in the quantity of waste produced in recent decades due to augmented consumption, despite occasional decreases caused by the economic crises. This topic has important social, environmental, and financial effects due to the various involved actors: the governments responsible for defining waste management (WM) policies, the companies that carry out waste collection and disposal, and the citizens whose behaviors must comply with the governments' strategies. A tradeoff between environmental and financial implications should be accomplished through the responsible behavior of all stakeholders (Fisher-Vanden and Thorburn, 2011).

According to the European Union (EU), member states should monitor the full waste cycle from production to disposal following the hierarchical principle, whose aim is to prevent waste's negative environmental impacts: it advocates, in order of priority: reuse, recycling, other kinds of recovery (e.g. for energy production) and, finally, disposal (Gharfalkar et al., 2015). The hierarchical principle is not a new approach, though it has been strengthened through Directives 2006/12 and 2008/98 and recently reinforced by EU institutions with the circular economy action plan and new legislative proposals on waste (European Commission, 2015; European Parliament, 2017). In brief, considering that member states often experience a lack of natural resources, but abundant waste, they should seek ways to use waste more efficiently, defining policies to promote the conversion of waste into resources that may be re-introduced into the economic system as secondary raw materials (Cossu and Williams, 2015).

Within this context, the present article focuses on Italian municipalities governing WM services in their territories according to specific policies, which should comply with the circular economy principles. The aim of this study is to understand whether and how WM choices oriented toward environmental protection

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and contextual factors influence WM companies' revenues and costs, which in turn affect their financial sustainability and ongoing viability. Revenues derive from selling recovered materials and produced energy and from fees paid by citizens, while costs derive from recurring operations (short-term evaluation) and investments (long-term evaluation), both related to waste collection, treatment, and disposal (Lohri et al., 2014). Thus, financial sustainability is strictly connected to firms' ability to preserve and improve such important utilities by realizing the WM policies defined by the municipalities, which should be increasingly compliant with the circular economy principles.

To consider the environmental implications of WM choices, we focus, first, on the separate waste collection carried out by each company in the served territories. Environmental sustainability is a wider concept that we have no claim to measure. Rather, we consider the activities required to start recycling as a pre-condition for compliance with the above mentioned hierarchical principle of the circular economy. Separate waste collection is essential for waste reuse, recycling, and recovery; thus, it can improve the environmental sustainability of a territory's human and economic activities.

Assessing the factors that could influence WM companies' financial sustainability is a particularly significant aim, given the future need to achieve EU environmental targets, as WM firms are among the most important for helping to realize these objectives. For this purpose, we have conducted a longitudinal empirical study of a group of companies providing MSW collection and disposal services to 880 municipalities across various Italian regions over the years 2012, 2013, and 2014. This represents an improvement to a previous study on the relationship between the environmental practices and financial performances of Italian WM companies (Bartolacci et al., 2018), compared to which this article is based on more municipalities and variables, and uses a more refined methodology.

This article is structured as follows: Section 2 reviews the literature on financial impact assessment in WM; Section 3 briefly presents the main aspects of the Italian WM sector and companies; Section 4 describes the research methodology; Section 5 analyses the results of the conducted empirical study; conclusions are given in Section 6.

2. Literature review

The financial impacts of policies related to environmental protection have been increasingly investigated in recent years; however, few studies have focused on the WM sector (Lucato et al., 2017; Qi et al., 2014).

The literature includes several studies of the costs and benefits of different WM choices, focusing particularly on such alternatives as recycling, biogas production, landfill, and other waste disposal processes. In these works, the authors highlight the availability of several options associated with the implementation of a MSW management system. Further, to identify an optimal solution, various technical, economic, environmental, and social aspects must be considered. Hence, analyses are usually conducted according to a broad evaluation framework of WM companies' performance, which examines various issues.

Costi et al. (2004) present a decision support system designed to help municipal decision makers develop integrated incineration, disposal, treatment, and recycling programs. The main goal is to plan MSW management by defining the refuse flows to be sent to recycling or to different treatment or disposal plants. In the analysis, the authors consider all possible WM costs and economic benefits resulting from the recovery of materials and energy.

Rubio-Romero et al. (2013) analyze the economic viability and profitability of potential biogas cogeneration from MSW produced

in Andalusia. The results show that a cogeneration system could help promote efficient waste collection and biogas exploitation. In addition, the income generated could help finance the investment made in the cogeneration plants, saving money that could benefit public entities.

Santibañez-Aguilar et al. (2015) propose a mathematical programming model for the optimal planning of the supply chain associated with the MSW management system to maximize the economic benefit while accounting for technical and environmental issues. The results show that it is possible to implement a distributed processing system to reuse MSW while maximizing the net supply chain profit.

Morin et al. (2010) investigate the financial results in terms of income produced by managing the organic fraction of MSW and municipal wastewater sludge through anaerobic digestion for a 150,000 inhabitant municipality. Zamorano et al. (2007) analyze the financial viability of landfill gas, assessing the costs and sales revenues of electricity generation.

With the aim of modeling and analyzing decision making in situations involving multiple stakeholders, Karmperis et al. (2013) survey decision support models commonly used in the MSW sector, such as life cycle assessment, cost-benefit analysis, and multi-criteria decision making. The authors suggest using a combination of these models to maximize their strengths and minimize their weaknesses, without neglecting any environmental, social, or economic aspects. Regarding the cost-benefit analysis model, they suggest conducting a financial analysis including an evaluation of financial sustainability.

The literature more strictly related to WM services and the financial impacts of specific variables, such as separated waste collection, population density, and the presence of disposal or treatment plants, focuses mainly on cost analyses (Abrate et al., 2014; Bartolacci et al., 2017; Bel and Fageda, 2010; Callan and Thomas, 2001; Greco et al., 2015; Larsen et al., 2010; Ohlsson, 2003). These authors often examine costs advantages in relation to the contextual variables and WM choices mentioned above.

Bartolacci et al. (2017) highlight the positive effects of separate waste collection rates in terms of the reduction of production costs for Italian WM companies, after adjusting the mean values of these costs to remove the impact of size factors. The findings show that even the population density factor has a significant effect on production costs, whereas the interaction between separate waste collection rate and population density is not statistically significant.

In the analysis of the impacts of the contextual factors, the costs of transport activities related to the extension of the served area assume an important role. Hiete et al. (2011) show that increased transport costs considerably reduce recycling rate, as recycling requires longer transport distances than disposal. Marinković et al. (2010) analyze the relationships between environmental impacts and transport distance, given the relevant influences on WM choices.

According to Ripa et al. (2017), one of the main burdens of WM is the transport of waste outside the region due to the lack of local treatment plants. The authors try to design and analyze six strategies that differ substantially in terms of separate waste collection rates, transportation routes, and options for the disposal of residual waste. The results show that it is possible to improve the environmental and economic efficiency of the WM chain locally, thereby strengthening the entire WM process.

The analysis conducted in the present study allow us to identify, on one hand, studies analyzing the impact of specific variables on WM costs, and, on the other hand, scientific contributions concerning WM companies' financial sustainability, which hardly ever analyzes aspects, e.g. contextual ones, that may influence revenues and costs. Rather, as highlighted, financial sustainability analysis is generally included in a broader evaluation framework of WM

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