



Cost-efficiency in packaging waste management: The case of Belgium



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ABSTRACT

In order to exploit economies of scale Belgian municipalities regularly cooperate in the provision of waste related services. In particular for the collection and separation of household packaging waste, municipalities appear to seek technical and cost efficiency gains by cooperating via municipal waste joint ventures. Although most Belgian municipal waste joint ventures can present excellent recycling and recovery rates for household packaging waste, their performance in terms of cost-efficiency has never been assessed. Using a unique dataset comprising of the costs for all 35 Belgian municipal waste joint ventures in 2010, this paper present the first assessment of the cost efficiency of household packaging waste collection in Belgium. As we are not sure on the relative importance of the separate cost efficiency scores for the three selectively collected household packaging waste fractions when determining the overall cost efficiency, this paper draws on the Benefit-of-the-Doubt approach. Our results indicate that, despite the substantial cooperation between municipalities, still considerable differences in cost efficiency for household packaging waste collection exist.

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1. Introduction

In 2010 the Belgian municipal waste joint ventures received almost 128 million euros from the green dot organization Fost Plus to finance their household packaging waste related activities. Although most waste joint ventures can present excellent recycling and recovery rates for household packaging waste, their performance in terms of cost efficiency has never been assessed. With national recycling targets of packaging waste that exceed the targets defined by the Packaging and Packaging waste directive of the EU (directive 94/62/EC amended by directives 2004/12/EC and 2005/20/EC) and a financial support model for the municipal waste joint ventures that does not explicitly promotes cost efficiency, an analysis of cost efficiency gains could prove very valuable for all stakeholders. In addition cost efficiency estimates of the entire municipal solid waste (MSW) management system for one of the three Belgian regions revealed that municipalities are in general rather cost inefficient in MSW collection and processing services (De Jaeger et al., 2011; Rogge and De Jaeger, 2012, 2013). This paper therefore aims at measuring the cost efficiency for selective collection efforts of household packaging waste in Belgium.

For this purpose we will build on a Benefit-of-the-Doubt (BoD) approach. This non-parametric tool, which is rooted in Data Envelopment Analysis (DEA), allows us to evaluate the comparative

overall cost efficiency performance of a set of similar activity units. In our case the method can be used to compute an overall cost efficiency score of the municipal joint ventures' collection efforts based upon the collection cost efficiency scores for the three selectively collected packaging waste fractions. The key feature of the BoD-model is that it uses an endogenous weight selection procedure in the aggregation of the multiple performance indicators. This is an important advantage as we are not sure on the exact importance of the cost efficiency scores of the separate waste fractions when determining the overall cost efficiency. In addition the use of so-called optimistic and pessimistic BoD-based evaluations will allow us to determine the range of cost efficiency values in which the exact cost efficiency score is believed to lie. This range can in turn be used to visualize the level of uncertainty of the collection cost efficiency ranking of each municipal joint venture. Finally an order-*m* version of the BoD model will be used as a robustness check.

Both effectiveness and efficiency of MSW management have received a substantial amount of attention in the international scientific literature during the last decades. A large part of studies focusing on the effectiveness (i.e. the relation between outcomes and desired policy objectives in MSW management), attempt to estimate the impact of unit based pricing on the disposal behavior by households. An overview of the latter studies (up to 2005) in Kinnaman (2006) reveals that the demand for MSW collection services is rather inelastic. However Kinnaman (2006) argues that unit based pricing has a more substantial impact on disposal behavior if households recycle little prior to the introduction of the unit based pricing system. More recently Allers and Hoeben (2010) showed that in the Netherlands user fees reduce the amount of unsorted

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waste and increase the amount of recycling, although the reduction in unsorted waste is much higher than the increase in recycling. For Belgium (Flanders) [Gellynck and Verhelst \(2007\)](#) found that the level of the bag price has a significant negative impact on the amount of unsorted waste collected. However their results also indicate that the ease of recycling (expressed as the number of waste fractions which are collected separately for recycling purposes) has no impact on the amount of unsorted waste collected. Next to the pure policy variables such as the characteristics of the unit based pricing program, many studies also include socioeconomic variables to explain recycling behavior. For instance [Jenkins et al. \(2003\)](#) found a significant effect of variables like age income and education on the intensity of recycling effort for recycling behavior of several materials in the United States. More recently, [Kipperberg \(2007\)](#) shows that socioeconomic characteristics are less important predictors of recycling behavior in Norway compared to the results of [Jenkins et al. \(2003\)](#).

Our paper fits within the second group, where the efficiency of waste management (i.e. to the relation between minimal inputs and maximal outputs of waste management) rather than the effectiveness is assessed. Recent additions to the literature include, amongst others, [Chen and Chen \(2012\)](#), [Chen et al. \(2010\)](#), [Marques and Simões \(2009\)](#), [Simões et al. \(2010\)](#) and [Simões and Marques \(2012\)](#). Efficiency studies of selective collection of packaging waste however, remain relative scarce. An interesting overview can be found in [Marques et al. \(2012a\)](#). The authors distinguish between studies that focus on the optimal percentage of recycling (see for instance [Lavee, 2007](#)), the market structure (a recent example is [Abrate et al., 2011](#)) and recycling costs. In the last category – the most relevant one in our case – some recent contributions have led to interesting new insights. For instance [Cruz et al. \(2012\)](#) analyzed the cost recovery rate for Portuguese local/regional authorities in the recycling of packaging waste. They found that if the opportunity costs of diverting the packaging waste from landfills are taken into account, the cost coverage is about 127%. Using a similar methodology [Marques et al. \(2012b\)](#) report cost coverage results of 135% for France. However for the local authorities in Romania the authors found a cost coverage of only 87%. Nevertheless adopting an economic perspective (i.e. including the opportunity costs), seems to have a significant impact on the conclusions. This is also confirmed by [Larsen et al. \(2010\)](#), where the authors argue that mainly due to the high cost for incineration avoided, municipal costs for collection and treatment of waste decrease with increasing recycling for the municipality of Aarhus in Denmark.

However the results presented in [Cruz et al. \(2012\)](#) and [Marques et al. \(2012b\)](#) also reveal rather high operational costs for selective collection and sorting for packaging waste compared to the costs of refuse collection and treatment. Similarly for the U.S. [Bohm et al. \(2010\)](#) report that both marginal as average costs are higher for recycling systems compared to waste collection and disposal services. Clearly, those proportional high operational costs can prompt questions about the cost-efficiency of selective collection and treatment of packaging waste. In order to stimulate an efficient packaging waste management system, some countries therefore implemented contribution schemes which depend on the performance of the local authority. For instance in France and Portugal the financial support for the local authorities organizing the collection of packaging waste depends on the per capita collection results ([Marques et al., 2012b](#)). The impact of such financial models on cost-efficiency remains a topic for further research, but the possibility to realize cost-efficiency gains has already received some interest from scholars. For instance after analyzing the main determinants of collection rates of household plastic packaging waste in Swedish municipalities, [Hage and Söderholm \(2008\)](#) tentatively conclude that national collection of plastic packaging waste in Sweden could be cost-inefficient. The authors argue that

in particular the compensation system for the waste collection operators tends to reduce regional cost differences. Similarly, when applying several non-parametric models to measure the efficiency of Portuguese recycling companies, [Marques et al. \(2012a\)](#) found significant inefficiencies. The authors conclude that a lack of incentives is one of the main reasons for the poor performance and recommend a funding scheme system based on more than the amount of packaging waste collected per capita.

Given the above considerations, we believe that our paper could contribute in several ways. First, the empirical evidence presented in this paper could fuel further discussion on the appropriate funding scheme to promote efficiency gains in selective packaging waste collection. Secondly the results could be highly relevant for both the joint ventures as well as the policy makers on local and regional level. Finally, to our best knowledge, this is the first paper that employs optimistic and pessimistic BoD-based evaluations to analyze the efficiency of packaging waste collection efforts (Section 4).

2. Institutional background

Although packaging waste management in Belgium is an area where essential authority remains with the regional governments, a cooperation agreements effectively aligns packaging waste policy between Flanders, Wallonia and the Brussels-Capital region. An important task hereby is monitoring the so-called extended producer responsibility for packaging waste. This responsibility implies that every company responsible for bringing more than 300 kg of packaging material on the Belgian market must meet the recovery and recycling quotas specified in the cooperation agreement. The quotas include both general targets as minimum recycling targets for a number of specific waste streams (see [Table 1](#) for an overview). The general targets require that minimum 80% of the packaging material should be recycled – i.e. reintroduced in a production process – and minimum 90% of the packaging material should be recovered – i.e. recycled or incinerated with energy recovery. For instance a company responsible for bringing 50 metric tons of packaging material on the Belgian market has to prove that minimum 40 metric tons of the material are recycled and minimum 5 additional metric tons are recovered.

Clearly it would be economically inefficient for each company to organize its own collection and separation program. Therefore the vast majority of the companies conclude an agreement with the officially accredited organization fulfilling the extended producer responsibility objectives for the industry (this is currently the non-profit organization Fost Plus). In terms of quantities of packaging waste, [Fost Plus \(2011\)](#) reports that of the estimated 817,171 metric tons brought onto market in 2010, about 690,828 metric tons were recycled via Fost Plus. In practice the member companies pay a fee, or Green Dot tariff, to Fost Plus. In return Fost Plus promotes, coordinates and finances the selective collection of a number of household packaging waste fractions. These include glass, paper and cardboard and the so-called PMD fraction. The latter fraction consists of plastic bottles and flasks, packaging metals and drinks cartons and is collected on the curbside in a single bag. Next to the collection, Fost Plus also finances the separation of the PMD fraction into, amongst others, steel, aluminum, PET (Polyethylene Terephthalate) and HDPE (High Density Polyethylene). Although Fost Plus uses its revenues to finance household packaging waste management, the responsibility to organize the collection and separation of packaging waste remains, in theory, at the municipal level. However to exploit economies of scale when providing this service, almost all Belgian municipalities engage in inter-municipal cooperation (IMC) with other, often neighboring municipalities via so called municipal waste joint ventures. In 2010, 585 of the 589

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