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Deposit-refund system vs. compliance scheme membership: How to comply with producer responsibility regulations?

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ABSTRACT

This study models and analyzes two alternatives available for producers to comply with the producer responsibility regulations: (i) individual compliance alternative, which is modeled through a producer-managed deposit-refund system and (ii) collective compliance, which is modeled through a compliance scheme network managed by an authorized organization. We provide closed-form solutions for both models and analyze the impact of various parameters (e.g., price for recyclable materials, recycling yield, the legally required recycling rate) on the minimum cost to be incurred by a producer and the return/recycling rate under each model. We also compare the two models with respect to the return/recycling rate and the producer cost. As a result of our analysis, we observe that the deposit-refund model guarantees lower cost for the producer while the compliance scheme ensures a slightly higher return/recycling rate on average. The cost advantage of the deposit-refund model augments for packaging materials with a higher recycling value, but is weakened by the legally imposed recycling rate.

1. Introduction

Starting from 90s many countries have enacted regulations based on the Extended Producer Responsibility (EPR) principle to tackle with the environmental problems stemming from end-of-life/end-of-use consumer goods. One of the earliest and most prevalent of these regulations concerns packaging materials and holds the producers who use packaging materials in their sales responsible for the end-of-life treatment of these materials. The most well-known regulation on packaging materials is the EU Directive on Packaging and Packaging Waste (94/62/EC and 2004/12/EC). The Directive requires Member States to ensure that the collection systems are set up to meet the collection and recycling targets set in the Directive (i.e., 60% by weight for glass, 50% by weight for metals, 22.5% by weight for plastics). The Directive has been transposed to national regulations in all EU members as well as some other countries such as Macedonia, Serbia, and Israel. Most of these national regulations (e.g., in France, Germany, UK) provide producers two alternatives to fulfill their responsibilities. A producer can either make her own plan and set up her individual system to collect packaging materials arising from her products or she may transfer her responsibilities to an authorized organization by paying a fee. In this paper, we analyze and compare these two alternatives both from the perspective of producers and the environment. We model the first alternative as a *deposit-refund system* managed by the producer herself and the second one as *a compliance scheme* managed by an authorized organization.

Compliance schemes, which are generally founded by an association of producers or the industry, are more common especially for municipal packaging in practice (e.g., DSD in Germany, Eco Emballages in France, SPV in Portugal, and CEVKO in Turkey). Producers who join a compliance scheme pay a fee mostly based on their sales and the scheme uses the money collected to meet the obligations of the producers (European Commission DGXI.E.3, 2001; Mayers, 2007). For the tasks of collection, sorting, and preparation for recycling, compliance schemes usually make contracts with licensed firms or with municipalities (European Commission DGXI.E.3, 2001). In many countries, separate collection is adopted. For this purpose, colored containers for different packaging materials are located at convenient places (e.g., at supermarkets, schools, and hospitals) in residential areas. Licensed firms pick up and transfer the collected materials from these places to licensed recycling firms or recycle themselves if they also have a recycling facility and license, and then report the amounts sent to recycling to the compliance scheme.

Deposit-refund systems, which have been acknowledged as an efficient way of used product take-back in several studies (e.g., Bohm, 1981, Palmer and Walls, 1997; Numata, 2009), can provide a producer with the opportunity to manage her own take-back system. Deposit-refund

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systems may also be set up industry-wide (e.g., as in Finland for metal cans and plastic bottles or as in Denmark for beverage containers). However, in this study we consider a deposit-refund system managed by the producer herself, which has been used by many big producers (e.g., Coca Cola, beer manufacturers) for years. There are two main reasons for this choice. First of all the packaging regulations offer a producer the alternative of setting her own system to fulfill her recycling obligation (Mayers, 2007; Hage, 2007), and a very convenient and cost efficient way of this is a deposit-refund system. Hage (2007) reports that in Sweden about 240 producers set up their own system to fulfill their recycling responsibility. Moreover, an individual deposit-refund system, which gives all the control of the take-back network to the producer, accords with one of the main goals of the EPR based regulations, which is encouraging environmentally conscious production practices by transferring the responsibility of end-of-life/end-of-use product treatment to producers. In an industry-wide deposit-refund system, however, the producers do not have much control over their used products and cannot manage the take-back network for their products.

The two alternatives involve different network structures with different advantages and disadvantages for a producer. First of all, compliance scheme membership offers an easy way of fulfilling obligations and keep producers away from any administrative work (e.g., reporting and coordinating the different parties involved in the network). Also, compared to a single producer, a compliance scheme has a higher bargaining power and may negotiate with the licensed firms for lower service fees on behalf of its members. Furthermore, since the compliance scheme is entitled to collect all the packaging materials of a given type in a certain region regardless of the brand name, the material waste pool of a compliance scheme is larger than that of an individual producer. On the other hand, deposit-refund system provides a producer the opportunity of controlling and optimizing the whole network in her own best interests. In this way, the producer may retain any profit that may be obtained from selling the collected packages to recycling. Moreover, the deposit, which is an important monetary incentive to increase the return and recycling rates, may also serve as a revenue for the producer if the consumers do not turn back the empty package. Still, the deposit fee will affect the sales of the producer as well (Numata, 2009). Since the deposit may be regarded as a price increase, the producer may lose some of her customers. Hence, under different conditions (i.e., recycling market price, costs, and consumer willingness to turn back empty packages), the better system for the producers or for the environment may change. This study aims to shed some light on this issue.

2. Literature review

This study pertains to two main research streams: (1) in terms of the research topic, alternative collection networks to comply with the EPR legislation on waste packaging materials and (2) in terms of the methodology, game theoretic models and in particular auctions. As already mentioned producers may fulfill their collection and recycling obligations for packaging materials by either a producer managed deposit-refund system or by joining a compliance scheme. While the studies on compliance schemes are scant, deposit-refund systems have been widely investigated as a policy tool in the literature. One of the earliest work on deposit-refund systems is Bohm (1981) where deposit-refund is thoroughly examined as both a governmental and a firm-level policy tool. The author concludes that the deposit may boost the return of used products, however the same positive effect may not be observed in the amount of waste generated. More recent studies particularly in environmental economics literature (e.g., Palmer and Walls, 1997; Palmer et al., 1996) compare deposit-refund systems with alternative waste management policies such as advanced disposal fees, recycling subsidies, and recycled content standards. These studies consider the deposit-refund as a governmental policy and evaluate it by maximizing the social welfare. They do not look at the problem from the perspective of an individual firm but from the perspective of the society. In the same vein, Numata (2009) proposes two possible measures, handling fee paid to retailers and allowing retailers to keep unredeemed deposits, for mitigating the negative impacts of deposit-refund systems on retailers. The author finds that paying handling fee can mitigate the retailer's losses without affecting the social surplus while leaving unredeemed deposits to the retailer is not always optimal with respect to the social welfare. This study also considers the deposit-refund system as a government-managed tool similar to the previous studies. Our study differentiates from these studies with its focus on a deposit system managed by the producer as a policy tool for individual compliance. Closer to our work, Wojanowski et al. (2007) model a deposit-refund system managed by the producer to determine the optimal location of collection and retail facilities, and the optimal price which includes the deposit as well. However, the authors cannot provide an analytical solution due to the complexity of their model; through a numeric case they show that the producer will not take-back products if the value of returns is low and in this case government intervention is needed. Atamer et al. (2013) investigate the pricing and production decisions for reusable containers in a context where an individual producer either reuses the containers purchased from the consumers or brand-new ones.

On a more empirical basis, Lavee (2010) provides a cost–benefit analysis of the deposit-refund program applied to beverage containers in Israel. da Cruz et al. (2012, 2014) investigate whether the cost of packaging waste management systems is actually met by the industry (the producers) as required in the EU Directive. da Cruz et al. (2012) find that the Green Dot company (a compliance scheme) in Portugal only bears 77% of the costs of the financial system for packaging waste treatment. Groot et al. (2015) also provide a cost analysis of packaging waste collection system in the Netherlands, where two separation schemes (post- and source separation) and two collection schemes (curb-side and drop-off) are compared. Gonzalez-Torre et al. (2004) compare Spain and Belgium in terms of the relations among bottling firms, bottle manufacturers, and consumers in implementing environmental practices. However, none of these studies consider the alternative of individual compliance to the packaging directive. Atasu and Subramanian (2012) compare the individual and collective compliance in encouraging design for remanufacturing. However, the focus of this paper is on the cost differences between the two legislative forms (individual vs. collective responsibility) rather than the alternatives available to a producer for collection or take-back of its products as in our study.

There are not many studies on compliance schemes. Hage (2007) gives details on how the waste management system works for paper packaging in Sweden, which is indeed a compliance scheme system. By developing a theoretical general equilibrium model, the author notes that an individual producer responsibility system would both be socially efficient and lead to waste reduction. Compliance schemes are also called Producer Responsibility Organizations (PROs) and they are used for other product categories where producer responsibility regulations are in place (e.g., Waste Electrical Electronic Equipment and End-of-Life Vehicles). Mayers and Butler (2013) examine the operations of PROs over a case study of European Recycling Platform which is a compliance scheme for WEEE. Similarly, Mayers (2007) discusses the implementation of the waste treatment directives for packaging, batteries, and WEEE through PROs and examines their problems in the Europe.