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The organization of extended producer responsibility in waste policy with product differentiation

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ABSTRACT

The paper analyzes the efficiency of extended producer responsibility (EPR) for waste management. We consider a vertically differentiated duopoly where endogenous market quality affects waste disposal costs. Each producer has to meet a take-back requirement that forces it to collect and treat the waste associated with its products. In line with reality, we assume that the producers either organize themselves individually or cooperate by setting up a producer responsibility organization (PRO). We study the various implementations of EPR. Central to the analysis is the trade-off between collusion through the PRO and market power in the waste industry.

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1. Introduction

An increasingly popular instrument for solving solid waste management problems is the extended producer responsibility (EPR) program in which the government assigns to producers the responsibility—financial or physical—for the treatment or disposal of their products at the end of life. It is expected that such programs provide incentives to prevent waste at the source, promote environment-friendly product design, and support the achievement of public recycling and materials management goals. This paper develops a formal model of an extended producer responsibility program. We analyze the welfare effects of EPR policy approach and the way a welfare-maximizing authority should regulate EPR programs.

The first EPR program began in 1991 with the seminal German Green Dot scheme, which deals with packaging waste. EPR programs across the globe now concern a wide range of product groups and waste streams, such as packaging, electrical appliances and electronics, batteries and accumulators, used oil, tires, and end-of-life vehicles [10]. This trend toward requiring companies to assume responsibility for their products after use appears in the European Union, Japan, South Korea, Canada, and other countries (the USA constitutes a noteworthy exception).

The core of any EPR program is either a take-back requirement mandating individual producers to collect and treat the waste generated, or a legal obligation to finance these activities. In addition, the regulator frequently sets recycling objectives. Producers can implement individual solutions to fulfill their obligations. For example, the European Directive 2000/53/CE adopted in 2000 requires car manufacturers to take back end-of-life vehicles without charging fees. In most EU countries, each manufacturer has decided to launch its own program by contracting with car dismantlers and shredders.

However, bearing the responsibility may be very costly for individual producers. Imagine the Coca Cola Company setting up a system on its own to deal with waste generated by its Coke cans and bottles. To reduce the cost, companies can

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organize themselves collectively by creating a so-called producer responsibility organization (PRO), which is a non-profit organization controlled by the producers. Its primary task is to set up and manage the infrastructures that organize the collection and processing of waste on behalf of their individual members. A salient example is the *Duales System Deutschland* (DSD) GmbH created under the Green Dot program.

The way in which individual producers finance the PRO is a crucial aspect of EPR design, since the method chosen directly influences the size of the incentives to prevent waste. The usual instrument consists of a fee per unit of product that each producer puts on the market. The product fee is frequently uniform across brands (e.g., \$20 per refrigerator). It can also take into account waste-related product characteristics. This is the case of packaging PROs like DSD, for which the fee rates vary across materials and depend on the weight and size of each packaging type. In this paper we consider both uniform fees and incentive fees which reward individual prevention efforts.¹

Most importantly, each EPR program is designed by the producers. The very concept of EPR is based precisely on giving producers considerable freedom in the way they meet their obligations. This feature raises several efficiency questions. Is the assignment of an EPR to individual producers sufficient to obtain a socially efficient outcome? Or should regulators intervene in the producers' decisions to cooperate in a PRO? Should the way producers finance the PRO be regulated? More generally, do PROs allow for collusion? The paper addresses these questions.

We consider a duopoly model in which each producer faces a take-back requirement that forces it to manage waste generated by the consumption of its products. We assume that the producer can either get organized individually or cooperate with others. Cooperation consists in setting up a producer responsibility organization that collects and treats waste on behalf of producers. We endogenize the producers' decisions with respect to the contribution schedule for financing PRO activities.

A crucial feature of the model is that products are differentiated. Product differentiation is pervasive in real-world markets where EPR is implemented (cars, electrical appliances, food products, etc.). We also assume that market quality affects waste disposal costs. The quality has either a positive impact on waste management by reducing disposal costs, as in the case of product durability, or a negative impact when a high quality entails larger end-of-life costs, as in the case of sophisticated packaging. In a variant of the model we also consider the possibility that producers contract out to waste management companies which have market power.

We show that individual EPR programs generally fail to implement the first best optimum. Setting up a PRO presents an additional risk of collusion. In this regard, the analysis stresses the need to regulate the tariffs which finance the PRO activities. The paper provides useful guidelines for doing so.

The theoretical literature on EPR programs is still very scarce. Only Runkel [12] explicitly addresses EPR. He analyzes the efficiency of several EPR instruments under perfect and imperfect competition, focusing on product durability. He shows how imperfect competition in the product market can damage the efficiency of an EPR program, due to the relationship between waste-related characteristics (product durability) and demand.

Our paper is more general. In a unified framework, we deal with cases where market quality is negatively correlated with waste disposal costs, such as the durability of goods, and with cases where the correlation is positive, as it can be with packaging complexity. We also extend Runkel's approach by endogenizing the design of EPR programs. In his setting, the EPR instruments are exogenous, meaning that they are not selected by producers facing an EPR obligation. By contrast, we see EPR as a mechanism of delegation of waste policies to producers. Accordingly, the core of our model is the evaluation of the impact of producers' decisions on the design of the EPR program. We are thus able to analyze collusion issues.

In Runkel's sense, many other papers deal with EPR instruments, namely exogenous upstream instruments targeting producers. Papers deal with recycling standards [11], take-back requirements, and various product taxes based on recyclability or waste content [1,5–8,13]. They analyze a wider spectrum of waste policy instruments than ours and compare their efficiency. They all assume perfect competition. Both Runkel's work and ours show how imperfect competition has crucial implications for the results obtained.

Finally, the paper is also related to the literature on environmental product differentiation [2,3,9]. In this regard our main contribution is to focus on EPR specificities: collusion in the product market through the PRO or the impact of market power in downstream waste markets. But we discuss where necessary—in particular in Section 3—how some of our results relate to this literature.

2. The model

We consider two producers of a consumption good that generates end-of-life waste. Both producers have to meet a take-back requirement that forces them to bear the full cost of waste collection and disposal. They can either set up their own scheme to meet EPR obligations or cooperate by implementing a PRO. They can also differentiate their product quality to relax competition. The key here is the fact that the differentiation parameter—market quality—affects waste

¹ The practicability of incentive fees varies across products. For instance, packaging is a simple good for which variable fees are relatively easy to implement for two reasons: the number of waste-related parameters is limited (packaging weight, size and type of materials) and these parameters are easy to monitor. For more complex goods, such as electrical appliances and electronics, incentive fees are more difficult to implement.

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