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Competitive strategy in remanufacturing and the impact of take-back laws

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Abstract

This paper examines the impact of take-back laws within a manufacturer/remanufacturer competitive framework. Take-back laws require that firms take responsibility for the collection/disposal costs of their products. We consider two alternative implementations of take-back laws that are distinguished by the degree of control that the manufacturer has on returns sold to the remanufacturer. In one implementation, known as collective WEEE take-back, the manufacturer has no control over returns sold to the remanufacturer. The other implementation, known as individual WEEE take-back, gives complete control to the manufacturer.

We develop a general two-period model to investigate questions of interest to policy-makers in government and managers in industry. Our results suggest that, in some settings, enactment of collective WEEE take-back will result in higher manufacturer and remanufacturer profits while simultaneously spurring remanufacturing activity and reducing the tax burden on society. A negative effect is higher consumer prices in the market. In other settings, we find that collective WEEE take-back introduces a structural change to the industry—creating an environment where remanufacturing becomes profitable when it is not profitable without a take-back law. With respect to individual WEEE take-back, we find that the manufacturer often benefits from allowing the remanufacturer to enter the market, though from a government policy-maker perspective, there are clear risks of monopolistic behavior.

Keywords: Remanufacturing; Environmental laws; Pricing; Competitive strategy; Reverse logistics; Closed loop supply chains

1. Introduction

As of 1996, the remanufacturing industry was a US$ 53 billion industry of approximately 73,000 remanufacturing firms (Lund, 1996). The sales figures were on par with the American steel industry. However, the direct employment figure of 480,000 was twice that of the American steel industry and equaled that of the consumer durables industry (Lund, 1996). Giuntini and Gaudette (2003) affirm that even though remanufacturable prices are typically 30–40% lower than new products, remanufactured products cost 40–65% less than new products to produce. An estimated 120 trillion BTUs per year of energy are saved from remanufacturing globally, accounting for about 16 million barrels of crude oil and about US$ 500 million in energy costs. Annual material savings resulting from remanufacturing activities worldwide is 14 million tonnes per year, which is the equivalent of a fully loaded railway train 1650 miles long (Giuntini and Gaudette, 2003).

The motivation for remanufacturing is driven by economic considerations (Ginsberg, 2001; Toffel, 2003)

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and, in recent years, legislators have started to mandate it. In December 2002, New Jersey enacted the Universal Waste Regulations Act, which governs the disposal of all electronic devices including computers. Under this regulation, organizations accumulating more than 220 pounds of universal waste at any time are designated as "small quantity universal waste handlers." Responsibilities of such small quantity universal waste handlers include shipping the waste to a registered universal waste facility (http://www.thegreenpc.com/). The European Union (EU) has adopted a Directive on Waste Electrical and Electronic Equipment (WEEE) such that, effective August 2005, EU member states must establish collection systems for electrical and electronics waste. Manufacturers bear all costs from collection points to waste treatment. Pending Minnesota bills such as HF 882 and SF 838 would make electronics manufacturers responsible for collection/disposal costs. In January 2005, California enacted the Electronic Waste Recycling Fee (SB20), which requires retailers to collect from consumers an electronic waste recycling fee on electronic devices (presently limited to video displays) to cover the net cost of a state authorized collector who collects, consolidates and transports electronic wastes. Maine enacted the Extended Producer Responsibility Act (LD 1892) by which municipalities collect electronics and invoice the manufacturers of returned product for the cost of collection and transport to recyclers.

Residing in a state with no current disposal regulations does not exempt one from the risk of improper disposal. Interstate commerce laws mandate that any product between states must meet with the laws of each of the states the product passes over. Since one has no control of a disposed computer's eventual destination, it is essential to ensure that products meet the most stringent laws practiced in any state in the U.S. In Europe, under stiff recycling requirements, no more than 15% of a scrap vehicle can go to a landfill, and that target percentage drops to 5% in 2015 (http://www.reman.rit.edu/).

The growing cost of landfill usage and the implementation of recent bills have lent support to the remanufacturing cause. These acts and other proposed bills present interesting research questions for analysis and topics for policy debate. In fact, the United States Environmental Protection Agency and industry representatives such as the Electronic Industries Alliance have been weighing the merits of various recycling models and differing implementations of take-back laws, which require that manufacturers bear responsibility for costs associated with collection and disposal for end-of-life units (EIA, 2001).

In this paper, we seek to improve our understanding of the impact of take-back laws so as to guide government policy-makers and to inform corporate management. We compare and contrast a scenario where no take-back law is in effect with two possible implementations of a take-back law. The two take-back laws are distinguished by the degree of control that the manufacturer has on returns sold to the remanufacturer. In one implementation, the manufacturer has responsibility for collecting returns and has control over whether returns are recycled or sold to a remanufacturer. This implementation is known as *individual* WEEE take-back under the EU WEEE Directive. In another implementation, manufacturers pay a collection fee for returned product, and government has responsibility for collecting returns and has control over whether returns are recycled or sold to a remanufacturer. This implementation is known as *collective* WEEE take-back under the EU WEEE Directive.

We consider an industry where the manufacturer does not engage in remanufacturing. A remanufacturing process is quite different from a manufacturing process in terms of equipment and labor skills required for disassembly and repair of cores (Guide et al., 2000), and the majority of manufacturers do not remanufacture (Ferguson and Toktay, 2005). However, this attracts third party remanufacturers who can cannibalize sales of the original equipment manufacturer (OEM).

We analyze a two-period model where the manufacturer launches a new generation of a product in the first period. A remanufacturer acquires returns at the end of the first period, and the manufacturer and remanufacturer compete for sales in the second period. The life-cycle of the product is two periods, so there is no remanufacturing of returns at the end of the second period. Rather, the two-period cycle begins anew as a new generation of the product is introduced by the manufacturer.

An important element captured in our analysis is the impact of the return rate on costs and future sales. Guide et al. (2000) note that imperfect correlation between demand and returns may lead to an excess or shortage of returns, making inventory management of returns a difficult task. Furthermore, disposal costs for excess returns (i.e., returns not used in remanufacturing) can be significant, and are likely to increase in the future. The economic and social costs of disposal increase as landfills get filled up (Renkow, 1994) and environmental protection groups protest against dumping in third world countries (Taylor, 2002). Landfill valuation not only depends on present land values but also on the increased value of landfill space over time, and besides