

Chapter 2

Market Behavior Towards Remanufactured Products

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Abstract This chapter provides an overview of recent empirical research on market behavior towards remanufactured products. We focus on three key themes: factors influencing the differences in consumer valuation of new and remanufactured products, differences in perceived valuation of seller signals for new and remanufactured products, and impact of the presence of remanufactured products on consumer valuation of new products. The results point to the unique properties of remanufactured products and how they differ from new products. We posit that considering these findings could lead to an increase in the profit-generating capability of remanufactured products.

2.1 Introduction

The core principle in closed-loop supply chains is to recover the remaining value in end-of-use products after receiving them back from the market. The remanufactured products are attractive because manufacturers incur significantly lower costs from remanufactured products relative to the cost of producing their brand new counterparts. However, the traditional concern for many manufacturers is the potential cannibalization of their new product sales by remanufactured products. In fact, many organizations do not introduce remanufactured versions of their products. To test the validity of this concern and realize the profitability of remanufactured products, it is critical for manufacturers to realize how remanufactured products are perceived by consumers.

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Recent empirical studies show that the perceived value of new products can be significantly different from the perception of remanufactured products. In this chapter, we focus on three key themes: (1) factors influencing the differences in consumer valuation of new and remanufactured products, (2) differences in perceived valuation of seller signals for new and remanufactured products, and (3) impact of the presence of remanufactured products on consumer valuation of new products. We utilize the findings from three empirical studies by Subramanian and Subramanyam (2012), Subramanian et al. (2015), and Agrawal et al. (2015) in discussion of these themes, respectively.

We first focus on how the factors influencing consumers' valuation of new and remanufactured products may differ. Subramanian and Subramanyam (2012) show that both seller reputation and seller identity (original equipment manufacturer (OEM) vs. third-party remanufacturer) play a significant role in explaining the differences in valuation of new and remanufactured products. Surprisingly, they find that specifying a warranty does not have a significant role in explaining the differences in valuation. This finding suggests that offering a warranty for a remanufactured product may not be an effective signaling tool like it can be for new products.

If a warranty for a remanufactured product is not useful, which signals can effectively influence the valuation of remanufactured products? There are multiple safeguards available to sellers, particularly in online marketplaces, which are designed to alleviate the consumers' concerns about product's condition. Traditionally, seller-related safeguards (e.g., seller reputation) are designed to alleviate consumer concerns related to seller trustworthiness or integrity, along with product-related safeguards (e.g., returns acceptance) that are designed to reduce the concerns related to product condition. Subramanian et al. (2015) show that both seller feedback score and returns acceptance influence the valuation of remanufactured products in online marketplaces. They also find that the impact of specifying returns acceptance amplifies when this signal is specified by sellers with a high reputation for remanufactured products. We focus on this unique finding for remanufactured products in the discussion of the second theme.

In the discussion of the third theme, we focus on another unique property of remanufactured products: the influence of the presence of remanufactured products on consumer valuation of their new counterparts. Agrawal et al. (2015) find that the valuations of new and remanufactured products indeed interact when they are present in the marketplace at the same time. In particular, they show that the presence of an OEM remanufactured product decreases the valuation of its new counterpart, while the presence of a third-party remanufactured product increases the valuation of its new counterpart.

The rest of this chapter is organized as follows. In Sect. 2.2, we explore why remanufactured products are perceived differently from their new counterparts. In Sect. 2.3, we focus on the first theme to highlight the key factors influencing the differences in consumers' valuation of remanufactured and new

products. In Sect. 2.4, we discuss the second theme to look at the influences of sellers signals on consumer valuation of new and remanufactured products. In Sect. 2.5, we elaborate more on the third theme to discuss the impact of the presence of remanufactured products on the perceived value of new products. We conclude in Sect. 2.6.

2.2 Unobservable Remanufacturing Processes

The United Nations Environment Programme (UNEP) defines remanufacturing as the process of returning “used products and individual product components to a ‘like-new’ functional state” (2013). Typically, recovery of a used product to its original condition requires the implementation of a set of tasks including: product disassembly, component servicing, component testing, and reassembly. These processes are unobservable to consumers, so the term *re-manufactured* can incite more questions than confidence on the current state of the product. For example, consumers do not observe whether the remanufacturer carries out full or partial disassembly, inspects all components, uses the original parts as replacements, and tests each part in accordance with the OEM specifications.

With the 15 % growth in the remanufacturing industry in the United States over 2009–2011 (USITC 2012), both practitioners and scholars are examining how best to reduce the consumer concerns related to the purchase of remanufactured products to increase the sales further. Some OEMs disclose full information about the entire remanufacturing process on their web sites in an attempt to reduce the uncertainty. For instance, HP has a section on its web site titled “Why buy refurbished?” (HP 2015). Apple states that their refurbished Macs go through an extremely thorough refurbishment process to make sure it is up to the quality standards of a brand new Apple product (Jacobs 2011). Such strategies are common in the marketplace.

Another strategy to deal with consumer uncertainty is to provide a warranty to signal the quality of the remanufactured product. Consumers will be looking for signals to indicate the quality of the remanufactured product relative to its new version. In that case, providing the same warranty for both the remanufactured and new versions will imply that the producer has equal confidence about the quality of both versions of the product. Apple provides a standard 1-year limited warranty; a customer can purchase an AppleCare Protection Plan for the remanufactured product until the end of the first year just like buying the plan for a new version of the product.

Although these strategies are practically feasible for OEMs in the industry, their impact on the perception of remanufactured products is likely to vary in online marketplaces. Online marketplaces increase the accessibility to products that are remanufactured by third-party manufacturers. Yet, consumers do not have physical interactions with a product offered online prior to purchase. Hence, their concerns are likely higher and influence their purchasing and bidding behavior.

With the remarkable increase in market size for remanufactured products due to online marketplaces, both the original equipment and third-party manufacturers face the challenge of setting up a careful strategy to ease consumer uncertainties, and increase the valuation, and purchase for remanufactured products in online marketplaces. Although the expectation is that remanufactured products should be “like-new,” we still see significant price differences between new and remanufactured products in online marketplaces. In a study of 250 remanufactured and 1979 new electronics products sold during the first 2 weeks of August 2009 on eBay, a comparison of the average prices for new and remanufactured products at the time of each remanufactured product transaction shows that 90 % of the observations have average new product prices greater than the average remanufactured product prices (Subramanian and Subramanyam 2012). Similarly, in an experimental study of bids from ascending-price auctions for new and remanufactured versions of two different types of products (Skil Jigsaw and Cisco security system), Guide and Li (2010) show that the average prices associated with the remanufactured versions are significantly lower than that of their new counterparts.

Such price differentials between remanufactured products and their new counterparts suggest that carrying out a rigorous process to make sure a remanufactured product is up to the quality standards of its new counterpart, and promoting such practice as part of a selling strategy, may not be sufficient for increasing the valuation, and purchase in online marketplaces. Seller- or market-related characteristics in marketplaces may have a significant influence on consumer behavior towards remanufactured products. Hence, a seller should understand which of these characteristics influence the differences in purchase behavior towards new and remanufactured products.

2.3 Factors Influencing the Valuation of Remanufactured Products

Online marketplaces provide diverse mechanisms for sellers to show their confidence in their products, such as product descriptions, product pictures, warranties, and specifications of money-back guarantees. Given the inherent information asymmetry between buyers and sellers, these mechanisms play a key role in decreasing consumer uncertainty by acting as safeguards, keeping more reputable sellers in the market, and hence drawing more potential buyers. In this section, we focus on the impact of these safeguards on the price differences observed between remanufactured products and their new counterparts.

Given the lack of a physical interaction with a product offered online, consumers often have to rely on signals of seller trustworthiness, such as online reputation score for the seller, signals of remanufacturer identity such as OEM versus third-party remanufacturer, and some transaction safeguards,

such as warranties. These mechanisms are designed to decrease consumer concerns and influence their purchasing behavior.

Seller reputation has been posited to play a key role in addressing buyer uncertainty in online marketplaces (Dewan and Hsu 2004). In many online marketplaces, consumers can see a summary of the seller's reputation. For instance, eBay provides a seller feedback score, as an indicator of reputation, in terms of counts and percentages of transaction feedback ratings over a certain time period and recent transaction history. Research on used products has shown that sellers with a higher reputation can alleviate consumers' concerns, and thereby command higher prices (Dellarocas 2003; Pavlou and Dimoka 2006; Ghose 2009). On top of the general problem of lack of experience with the product prior to an online purchase, unobservability of the remanufacturing process makes it harder for the consumer to determine the actual quality of a remanufactured product in online marketplaces. Hence, seller reputation is likely to have a significant impact on the prices achieved for remanufactured products in online marketplaces.

Subramanian and Subramanyam (2012) show that seller reputation has a significant relationship with the price differentials between new and remanufactured products. They find that greater negative reputation is associated with higher price differences between remanufactured products and their new counterparts, while higher positive reputation is associated with lower price differences between remanufactured products and their new counterparts. These results imply that an excellent reputation can help the seller to reduce consumer uncertainty, thereby facilitating the ability to command higher prices for their remanufactured products.

Researchers also explore why consumers treat third-party remanufactured products differently than products remanufactured by OEMs. From a practical standpoint, some remanufacturing processes may require excessive capital investments, which can only be sustained by OEMs. This suggests that consumers may prefer a OEM remanufactured product relative to a third-party remanufactured counterpart. The assumptions on such behavior in theoretical studies are also mixed: Ferrer and Swaminathan (2006) assume that consumers favor OEM remanufactured products over third-party remanufactured products, while Ferguson and Toktay (2006) assume consumers do not pay attention to whether the product is remanufactured by an OEM or a third-party manufacturer. Subramanian and Subramanyam (2012) empirically show that a seller can command higher prices for products remanufactured by OEMs than products remanufactured by third-parties.

Although there is an extensive literature on the impact of warranties on prices for used products, empirical evidence is scarce regarding consumer behavior towards warranties for remanufactured products. Warranties have been shown to ease the burden of information asymmetry, i.e., the "lemon" problem (Akerlof 1970), in the economics and marketing literature (Boulding and Kirmani 1993; Soberman 2003; Chu and Chintagunta 2011). This result implies that sellers can enjoy higher prices by providing warranties for their

products in online marketplaces (Pavlou and Dimoka 2006). However, Subramanian and Subramanyam (2012) find no statistical evidence of a positive relationship between offering warranties and the prices for remanufactured products. They state that other safeguards such as seller reputation and type of remanufacturer (OEM vs. third-party) may sufficiently mitigate consumer uncertainty, thereby reducing the need for warranties.

These findings point to a unique property of remanufactured products. In line with new products, seller reputation and seller identity also influence consumer valuation of remanufactured products. However, offering warranties for remanufactured products does not appear to have a significant influence on consumers' valuations.

2.4 Buyer Safeguards Influencing Market Behavior Toward Remanufactured Products

Seller use of diverse signaling mechanisms to mitigate consumer uncertainty for remanufactured products in online marketplaces may not be always effective for several reasons. First, few of these mechanisms can fully reduce consumer uncertainty, thereby eliminating the need for any other mechanism. Subramanian and Subramanyam (2012) use this reasoning to explain why warranties do not appear to have an influence on the prices for remanufactured products in the presence of other marketing mechanisms, such as seller reputation. Second, one mechanism can act to provide assurance for another mechanism. In this section, we focus on the impact of such interactions on consumer behavior toward remanufactured products.

Subramanian et al. (2015) explore the impact of the interaction between returns acceptance and seller feedback scores on prices for remanufactured products. Returns acceptance is another auction feature that serves as a safeguard for consumers. The signal does not require upfront costs from the seller, but it could prove to be a relatively expensive signal in the long run as a result of unexpected excessive returns. This suggests that a specification of returns acceptance can serve as a signal about the condition of a remanufactured item.

From a consumer's standpoint, it is hard to evaluate the condition of a remanufactured product prior to purchase knowing that a seller might not conduct all the required elements of a remanufacturing process. An offer of a returns acceptance demonstrates the seller's confidence in the remanufactured product to a defined original specifications.

One online selling tool shows a seller's capability for selling items as described. A seller's feedback score provides information on the buyers' responses to the products they received as compared to a comparable new product. Because their responses help mitigate consumer uncertainty, returns acceptance can be seen as a credible signal only if the seller's feedback score is high.

Subramanian et al. (2015) use data that include all auction listings for one particular category of remanufactured iPod Touches offered on eBay. They test whether seller feedback score influences the impact of returns acceptance on consumers' bids. Specifically, they test whether the specification of returns acceptance impacts the final prices for the iPod Touches. To understand the changes in the impact of returns acceptance, the tests for the items listed by sellers with low and high feedback scores are carried out separately. The authors find a statistically significant increase in the final prices of sellers with high feedback scores who specify returns acceptance, but no increase is identified for those sellers with low feedback scores. Thus, specifying returns acceptance does not influence consumers' purchase and bidding behavior for remanufactured iPod Touches when offered by sellers with low feedback scores.

Subramanian et al. (2015) also conduct the same tests for new iPod Touches on eBay. Since a new item does not require additional manufacturing processes such as disassembling or testing, it is not possible for its condition to be changed by the seller's efforts. This implies that specification of returns acceptance would not be valued differently based on the seller's feedback score. The authors find no statistical evidence for an increase in the final prices of new items for specification of returns acceptance when the seller has a high feedback score.

To the best of our knowledge, the research in this domain of closed-loop supply chains is fairly new. Researchers in this domain could provide some guidelines on how to design the features in online marketplaces differently for remanufactured products relative to their new counterparts.

2.5 Impact of Remanufactured Products on New Product Valuations

In this section, we discuss how consumers value new products in the presence of their remanufactured counterparts. Researchers examining the closed-loop supply chains (see Atasu et al. 2008; Guide and van Wassenhove 2009; Souza 2013 for recent overviews) have implicitly assumed that the presence of remanufactured products does not influence consumer behavior towards the new versions of the same product. This assumption implies that remanufactured products should not cannibalize the demand for their new counterparts, so any OEM may consider selling the remanufactured version of its products without the fear of cannibalization. Many OEMs nonetheless avoid selling remanufactured products. Moreover, their new products also face competition from third-party remanufactured counterparts.

Preliminary studies indicate significant differences in the perceived values of new, OEM, and third-party remanufactured products of the same type. Subramanian and Subramanyam (2012) observe that 90% of the

remanufactured transactions have prices lower than the average price of new products at the time of the transactions. Similarly, in an experimental study, Agrawal et al. (2015) find that the willingness-to-pay (WTPs) for remanufactured products are smaller than those for new products. Agrawal et al. (2015) also observe that the WTPs for OEM remanufactured products are higher than those for third-party remanufactured products.

Agrawal et al. (2015) expand on these findings and show that the presence of OEM remanufactured products has a negative effect on the WTPs for new products. They explain this finding based on the assimilation effects from the contextual reference points literature (McKenna 1984; Mussweiler 2003). An assimilation effect describes a shift in the valuation for a product towards one that acts as the contextual reference point for the consumer. Because the OEM remanufactured product is perceived to be very similar to its new counterpart, a consumer accepts the OEM remanufactured product as the contextual reference point, shifting the valuation for the new product downward (Agrawal et al. 2015). The presence of an OEM remanufactured product may also signal lower quality for the new counterpart because the remanufactured products would not exist without returns due to defects from the market. Consequently, the consumers' WTPs may go down as a result of perceiving it as such a signal.

In contrast, Agrawal et al. (2015) find that the presence of third-party remanufactured products has a positive effect on the WTPs for the new products. They explain this result with the contrast effects (McKenna 1984; Mussweiler 2003). Unlike the perceived similarities between an OEM remanufactured product and its new counterpart, a product being remanufactured by third-parties may trigger more questions than confidence because of uncertainties involved in conforming with the remanufacturing specifications. This will shift the valuation for the new product away from that of the third-party remanufactured product.

These findings point to another unique property of remanufactured products. While the presence of an OEM remanufactured product can decrease the valuation of its new counterpart, thereby lowering margins for the new product seller, the presence of a third-party remanufactured product can be beneficial for the seller by increasing the valuation of its new counterpart.

Research in this domain is still in its early stages relative to many other closed-loop supply chain domains. A promising direction for this domain is to test the similar claims using transaction-level data from secondary markets. Another promising direction is to test whether the same claims will hold in the presence of competition from other OEMs, as suggested by Agrawal et al. (2015).

2.6 Conclusions

Changes in today's marketplaces for remanufactured products (e.g., increasing availability in online marketplaces) involve multiple marketing mechanisms for sellers to influence consumer valuation for remanufactured products in addition to the traditional methods: promoting their remanufactured products being up to the quality standards of their new counterparts. A closer look at the consumers' concerns for a typical remanufacturing process shows that there are several seller- and market-related factors that can have differing effects on consumers' valuation of remanufactured products relative to new products.

Three themes are used in this chapter to differentiate remanufactured products from new products. Seller reputation and identity are found to be influential factors in consumers' valuation of remanufactured products, while offering warranties does not influence consumer valuation of remanufactured products. An analysis of the influence of multiple buyer safeguards as signals of the valuation of remanufactured products show that the positive influence of returns acceptance on consumer valuation amplifies when the seller has high reputation for remanufactured products, but not for their new counterparts. Finally, consumers' new product valuations are lower if its remanufactured counterpart in the market is OEM manufactured, and higher if it is remanufactured by a third-party.

These findings provide leads on how valuation of environmental goods can be different particularly in the remanufacturing context. We believe that these unique findings provide a broad picture of this landscape to the OEMs, which will help them devise strategies to deal with potential cannibalization from remanufactured products, and increase their sales and profit-generation capability. Higher remanufactured product sales will also aid in maximizing the environmental objectives stated by Eurostat (2009), such as control, restore, treat, and minimize environmental problems related to waste, biodiversity, and landscapes.

Even with all of these findings on seller- and market-related factors, additional questions remain on whether remanufactured products uniquely differ from their new counterparts when it comes to testing the influence of brand equity and working conditions. We refer the reader to the other chapters in this book: by Abbey and Guide for an overview of studies that examines how consumers perceive the brand equity for remanufactured products, and by Zheng, Kraft, and Valdes for an overview of how consumers' valuations may differ based on transparency of a firm's social responsibility practices.

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