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The impact of product upgrading on the decision of entrance to a secondary market

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ABSTRACT

In this paper, we examine the impact of manufacturers upgrading strategy of durable products on the decision of third-party entrant in a secondary market. To do so, we develop a two-period model in which a monopolistic manufacturer sells new durable products directly to end consumers in both periods, while a third-party entrant operates a reverse channel selling used products in the secondary market. The manufacturer releases an upgraded product (i.e., one that is technologically superior to the version introduced in the first period). We derive conditions under which it is optimal (1) for the manufacturer to release an upgraded product in the second period and (2) for a third party entrant to enter a secondary market. We also find, through numerical analysis, that when upgrades are typically small or moderate, the upgrading of new products can increase a third party entrant's profitability in the secondary market but it does not benefit the third party entrant when upgrades are typically large.

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1. Introduction

Upgrading is the process of replacing a product with a new higher quality version of the same product (e.g., one with a stronger function or higher performance, Anton & Biglaiser, 2013; Fudenberg & Tirole, 1998; Martin, 2011). Frequent introduction of upgraded products has been recognized as an important means by which firms continuously renew themselves in order to survive and prosper in a rapidly changing business environment (Anton & Biglaiser, 2013; Koufteros & Marcoulides, 2006) and is particularly noticeable in durable goods industries. For example, a new mobile phone model is introduced into the market with innovative agenda, camera, or Internet functions every month (Martin, 2011), while in the automobile industry, car makers introduce new components with every new model yearly. Similar patterns can be observed in other industries, including PCs, household appliances (e.g., washing machines, dryers, and vacuum cleaners), CRT devices (e.g., TV sets and monitors), and consumer electronics (Anton & Biglaiser, 2013). At the same time, however, trading used products in secondary markets is also a common practice in many durable

goods industries (Hendel & Lizzeri, 1999; Schiraldi & Nava, 2012; Shen & Willems, 2014; Shulman & Coughlan, 2007; Yin, Ray, Gurnani, & Animesh, 2010), including the used car and second-hand PCs, etc. As Computer Business Review (2005)¹ points out, these secondary markets have grown rapidly in recent years with third-party companies, for example, the PC industry building \$100+ million per year businesses in buying, selling, or leasing used computer equipment.

In this paper, we focus on the effect of product upgrading on third party used product retailer's entrance decision to the secondary market. Because an upgraded product gives consumers a higher utility, it will prompt those consumers who were planning to buy used products in the secondary markets to turn to the new products market for higher quality or performance. In this case, product upgrading will have a negative effect on the sales of used products, which will reduce the entrance propensity of a third party retailer. On the other hand, consumers earn a higher net benefit from replacing a used with an upgraded new product, so product upgrading will have a positive effect on the sales of used products, by ensuring greater availability of used products,

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E-mail address: xiongzhongkai@cqu.edu.cn (Z. Xiong).¹ Computer Business Review (2005). Big Players Emerge in Fragmented Brokerage Market. Accessed September 5, http://www.cbonline.com/news/big_players_emerge_in_fragmented_brokerage_market.

which obviously increase the entrance propensity. These observations raise an important question that warrants theoretical analysis: whether the manufacturer upgrading of new products actually affects the third party retailer's entrance decision to secondary market, and if so, how?

Yet the models used in previous research tend to ignore the effect of manufacturer's upgrading decisions on the secondary market and consider only these markets impacts on manufacturer's new product introduction strategies (e.g., (Fudenberg & Tirole, 1998; Yin et al., 2010; Zhao & Jagpal, 2006). Hence, in this paper, we focus on the effect of manufacturer's upgrading of new products on the sales of used products in the secondary market. To do so, we develop a dynamic two-period model in which a monopolistic manufacturer sells new durable products directly to end consumers in both periods, and a third-party entrant sells used products (i.e., those marketed in the first period) in the second period through a secondary market that is not directly controlled by the manufacturer. Our primary interest is in answering the following questions: Under what conditions it is optimal for a durable goods manufacturer to upgrade new products in the second period? What condition is needed for the third-party entrant to enter the secondary market in the second period? How does manufacturer upgrading degree affect the profits of channel partners? Hence our model differs from those previous studies in that it simultaneously considers an active secondary market, upgrading of new products, consumer market segmentation, and especially, the upgrade degree of new products as a function of consumer demand.

Our analysis reveals that when the investment cost of upgrading products is low, manufacturers do have an incentive to release an upgraded version in the second period, but when the investment cost is higher, they do not. Moreover, although the degree of upgrade always has a negative effect on the price of new products in the first period, its effect on the price of both used and new products in the second period is unimodal depending on intensity. We also find that the third-party entrant is likely to engage in the secondary market when the purchase cost of used products from former consumers is significantly low. Most importantly, we show that the upgrading of new products can increase the third-party entrants secondary market profitability when upgrades are typically minor or moderate but selling used products in the secondary market does not benefit the third-party entrant when upgrades are typically major.

The rest of the paper is organized as follows. Section 2 reviews the related literature and explains our contributions in more detail. Section 3 outlines the key elements of our model, as well as the derivation of the consumer demand function. Section 4 describes the model framework, presents the optimal equilibrium solutions for channel partners, and reports our main findings. Section 5 summarizes our conclusions and suggests opportunities for future research.

2. Relevant literature

Our paper is closely related to the broader literature on durable goods and new product development strategies; particularly, those studies that address (1) the dynamics between new and used products and (2) the interaction between the secondary market and the introduction of upgrades in the durable goods industry. The first stream of research, which is especially well established, includes (Fudenberg & Tirole, 1998; Levinthal & Purohit, 1989; Shulman & Coughlan, 2007). Levinthal and Purohit (1989) examine the optimal sales strategy for a monopolist marketing a durable product in an existing secondary market. They show that not only limiting initial sales lowers new product cannibalization but buying back the earlier version generates greater demand for the new product. Their

model, however, assuming that prices are linear functions of the cumulative quantities produced to date, does not allow nonbuyers from the first period to purchase in the second period. Fudenberg and Tirole (1998), in their analysis of firms dynamic pricing strategies in an existing secondary market, assumes that consumers in the market are homogeneous and the used market generates no profits for channel members. Based on heterogeneous consumers, Shulman and Coughlan (2007) show that the manufacturer earns higher profits from allowing used-good sales alongside new-good sales than from shutting down a retailer-profitable secondary market that expands the manufacturers unit sales beyond what is possible when only the primary market exists. These studies, however, ignore the effect of the new products upgrade on channel partners strategies. For further discussion of the relevant issues, see Bhaskaran and Gilbert (2005); Chen, Esteban, and Shum (2010); Desai, Koenigsberg, and Purohit (2004); Desai and Purohit (1998, 1999); Huang, Yang, and Anderson (2001); Pangburn and Stavroulaki (2014); Xiong, Yan, Fernandes, Xiong, and Guo (2012); Xiong, Zhou, Li, Chan, and Xiong (2013).

Our study is also related to the literature on the interaction between the secondary market and the introduction of upgrades in durable goods market. Zhao and Jagpal (2006), for instance, examine the effect of secondary markets for durable goods on a firm's dynamic pricing and new product introduction strategies. They find that secondary markets have differentiating effects on pricing across industries depending on the magnitudes of the innovation (major, moderate, or minor), and whether demand externalities are present. Martin (2011) then examines strategic behavior in a durable goods oligopoly where there is a positive probability of upgrade introduction. He argues that the presence of a secondary market not only increases the range of upgrades that are profitable but also raises profitability for a given upgrade quantity because former customers can be charged a higher price for the upgrade. Both studies, however, assume that used products are sold in an isolated channel while in reality, retailers sell used goods for profit in a co-opetition environment, for example, in textbook markets used book sellers not only cooperate with the manufacturers but are in competition with them. The presence of secondary market, therefore, especially one that is not directly controlled by the new product manufacturer, forces new product retailers or manufacturers to take used goods consumers into account when making business decisions. On the other hand, Yin et al. (2010), in their analysis of how the sequential emergence of retailer and P2P used goods markets shape both a manufacturers product upgrade strategy and a primary market retailers pricing strategy, assume that the retailer sells both used and new products for profit simultaneously. They find that frequent product upgrades and rising retail prices in durable product sectors results from the emergence of a P2P used goods market whose interaction with the retail used goods source alters the relative powers of the channel partners. In reaching this conclusion, however, they assume an exogenous segmentation of consumers who return used goods to the retail store or exchange them in P2P markets. For additional insights on this topic, see Esteban and Shum (2007); Fishman and Rob (2000); Kogan (2011); Kornish (2001); Lim and Tang (2006); Oraipoulos, Ferguson, and Toktay (2012).

Our paper differs from the extant literature in two ways: First, instead of ignoring the new product upgrade degree and paying little attention to its impact on consumer segmentation (particularly, consumer utilities), we endogenize this degree as a function of consumer demand (i.e., an endogenous segmentation of consumers). Second, rather than assuming that used goods are not sold through, or are sold outside, the standard channel, which ignores the effect of upgraded new product introduction in the secondary market, our dynamic model assumes that used products are sold by a third-party entrant in a secondary market not

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