



Product development capability and marketing strategy for new durable products

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ABSTRACT

Our objective is to understand how a firm's product development capability (PDC) affects the launch strategy for a durable product that is sequentially improved over time in a market where consumers have heterogeneous valuations for quality. We show that firms' launch strategies are affected by the degree to which consumers think ahead. However, only those firms' strategies that have a high PDC are affected by the observability of quality. When consumers are myopic and quality is observable, both high and low PDC firms use price skimming and restrict first-generation sales to consumers with a high willingness to pay (WTP). A high PDC firm, however, sells the second generation broadly, while a low PDC firm only sells the second generation to consumers with a low WTP. When consumers are myopic and quality is unobservable, a firm with a high PDC signals its quality by offering a low price for the first generation, which results in broad selling. The price of the second generation is set such that only high WTP consumers will buy. A firm with a low PDC will not mimic this strategy. If a low PDC firm sells the first-generation broadly, it cannot discriminate between high and low WTP consumers. When consumers are forward-looking, a firm with a high PDC sells the first generation broadly. This phenomenon mitigates the "Coase problem" that is created by consumers thinking ahead. The high PDC firm then only sells the second-generation product to the high WTP consumers. In contrast, a firm with a low PDC does the opposite; it only sells the first generation to high WTP consumers and the second generation broadly.

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1. Introduction

The quality of a product that provides unique value to consumers is often affected by the firm's product development capability. In some cases, firms that introduce new consumer electronics and appliances such as digital photo frames, specialized equipment, software, or high-end sporting goods have a well-known track record of introducing improved versions of their products over time. In other cases, firms are either unknown or have made limited improvements to products that have been in the market for a relatively long time.

Consider the evolution of the video game console market in the 1990s. In 1994, Sony entered the market and became the market leader with Playstation (PS) followed by the even more successful Playstation 2 (PS2) in 2000. PS2 offered improved user benefits such as internet connectivity and an inclusive DVD player (see for example, Ofek, 2008). Because Sony was new to the video console market, it is possible that purchasers of the first PS may not have foreseen the launch and benefits of PS2 when making the decision to buy PS.

In contrast, the launch of successive products in some markets is more predictable. Here, it is likely that consumers account for the potential benefits of future products when making a purchase decision. For example, since the launch of Apple's widely successful iPod in 2001, new and improved versions of this product have been introduced with high regularity, offering better storage, higher song capacity, improved screens, and increased functionality such as video and touch.²

When a firm develops new product versions by improving quality or performance over time, sales of a first (early) generation product often hinder the profitability of subsequent versions. Consumers who buy the first-generation product will have lower willingness to pay (WTP) for a new generation of the same product because they already have a functioning product. Accordingly, a supplier is restricted to charging existing consumers a maximum price that is equal to the incremental value of the new generation product. In other words, high performing, early generation products limit the price that can be charged for subsequent generations.³

² See, for example, the online features "Evolution of a Blockbuster" (<http://online.wsj.com/public/resources/documents/info-ipod0709.html>, retrieved on 31 July 2011) and "The New iPods" (<http://online.wsj.com/public/resources/documents/info-ipodcompare0709.html>, retrieved on 31 July 2011).

³ This is also the basis for the Coase problem whereby a durable good monopolist is not able to implement time-based discrimination due to customers' understanding that the price will drop over time (Coase, 1972).

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When launching the first product, a firm therefore faces the choice of employing price skimming (i.e., charging a high price and selling to a limited number of consumers with high WTP) or price penetration (i.e., selling the product to a broad set of consumers including those with low WTP). Price penetration may restrict the ability to charge higher prices for second-generation products because most potential buyers already have a first-generation product. We use the term “target breadth” as a shorthand term to describe the marketer’s choice of price skimming or price penetration described above.

To analyze how marketing strategy (i.e., the pricing of unique products over time) is affected by a firm’s product development capability (PDC), we propose a simple model. A model with two periods is the simplest way to represent firm dynamics in a context where the first generation of a product is improved upon through product development. We restrict the firm decisions to pricing for the first and second-generation products, and the level of investment in product development at the end of the first period to improve the product for the second period. These decisions constitute the most parsimonious set of decisions that can be used to understand how marketing strategies (the pricing of products over time) are affected by PDC.

We also examine how a firm’s strategy is affected by environmental factors such as how “deeply” (i.e., how far ahead) consumers think about a purchase and also how easy it is for consumers to assess the quality of products prior to purchase. In economics, unobserved quality is an important cause of market failure and the basis for a substantial amount of literature, including *Akerlof (1970)*. We analyze how a firm responds when it faces the problem of adverse selection, i.e., it has a high quality product, but consumers may not be willing to pay for high quality because they cannot be sure that the product is, in fact, high quality. In particular, we examine whether a firm will simply charge a price that is based on the expected value of a product or attempt to signal its high quality to consumers through actions. The questions of the paper can be summarized as follows:

- a) How does a firm’s PDC affect its introductory marketing strategy in terms of pricing (which determines “target breadth”) and its investment in product improvement when consumers are either myopic (they consider only the current benefits offered by the product) or forward-looking (they consider the expected value of the product in the future as well)?
- b) How are a firm’s launch strategies affected when consumers cannot assess product quality by inspection?

The key findings of our analysis are as follows:

- 1 A firm with a high PDC sets prices so that it sells both first- and second-generation products to consumers with a high WTP. In contrast, a firm with a low PDC focuses on intertemporal price discrimination and sells to each consumer type only once.
- 2 We show that the unobservability of quality changes the strategy of a firm with a high PDC because the firm will signal its quality by implementing penetration pricing (a strategy that a firm with a low PDC finds unattractive). This strategy leads to the unexpected observation that the first generation of a high quality product is sometimes priced lower than the first generation of a low quality product.
- 3 We show that when consumers are forward-looking, the launch strategies of firms change independently of their PDC. The change in strategy is driven by a reduced WTP of consumers for first-generation products.

Interestingly, the market strategies that are employed by a firm with a high PDC when quality is not observable and when consumers are forward looking are identical, namely: market penetration in period 1 and selling only to high WTP consumers in period 2. However, the reasons for adopting “market penetration in period 1 and restricting sales to high WTP consumers in period 2” are very

different. In the former case, it is the firm’s desire to signal its quality that leads to the lower introductory price. In the latter case, it is the consumers’ lower WTP that leads to the lower introductory price.

The remainder of the paper is organized as follows: *Section 2* provides a brief literature review. In *Section 3* we present a model of a monopolist selling to two types of myopic consumers. In *Section 4*, we first present the optimal strategies of the firm when quality is observable as well as when it is unobservable. Similarly, in *Section 5*, we present a model for forward-looking consumers when quality is observable as well as when it is unobservable.

2. Literature review

In many categories, new product generations appear on a regular basis. Nevertheless, research (e.g., *Abernathy & Utterback, 1978*) suggests that technological constraints and uncertainty inhibit the willingness of firms to introduce new product generations. With uncertainty, a sequential strategy is both “information yielding,” compared to an all-or-nothing crash program (*Weitzman, Newey, & Rabin, 1981*), and beneficial in a context of network externality (*Ellison & Fudenberg, 2000, Padmanabhan, Rajiv, & Srinivasan, 1997*). These benefits, however, are balanced by the reluctance of consumers to trade up to a new generation product (with higher marginal costs) when they already possess a functional first-generation product. Another factor driving the sequential generation of products is competition, either in R&D (“R&D races”) or in markets.

On the one hand, incumbent firms may invest more than entrants in R&D for subsequent innovations due to intellectual property rights and the diffusion of new products (*Banerjee & Sarvary, 2009*). On the other hand, prior success in R&D allows firms to gain reputation. Firms therefore trade-off R&D investment with reputation building (*Ofek & Sarvary, 2003*). In the absence of intellectual property rights, the possible entry of imitators may also drive incumbents to invest in developing a higher quality of new products (*Purohit, 1994*). Our research examines why a firm with market power may develop new product generations in the complete absence of competitive threats. Our objective is to show how launch and targeting strategies are affected by three factors: a firm’s PDC, the observability of product quality, and the degree to which consumers think ahead when making a purchase decision in the present.

Our research is also related to the durable goods literature which is reviewed by *Waldman (2003)*. Generally, durable goods literature focuses on the effect of secondhand markets, the role of commitment to future price (or quality), and adverse selection between new and used goods. Recently, the literature has examined the role of pricing in markets where new products are launched in a context of old (or used) products. The present work highlights a Coasian time inconsistency problem because of which the monopoly price for a current product is lower due to the expected launch of products in the future. A firm may therefore offer a lower quality current product to credibly commit to price and quality in the future (*Dhebar, 1994*). Similarly, *Moorthy and Png (1992)* show that a monopolist should launch a high quality product before launching a low quality product. The firm may, however, face difficulties in developing a high quality product first because a better performing product often requires additional R&D (*Langinier, 2005*). Moreover, the monopolist may want to sell a higher quality product later if it does not discriminate between past and new buyers (*Kornish, 2001*). In fact, when past buyers can be identified, a monopolist can price discriminate when launching a new product by either producing more of the older product, offering upgrade prices to past buyers, or buying back excess stock of the older product (*Fudenberg & Tirole, 1998*). We extend this literature by treating quality as an endogenous decision. This treatment of quality reflects the idea that better performing versions of a product become available for launch after a significant investment in R&D. We also

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