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ABSTRACT

In this study, we investigate two important questions related to dynamic pricing in distribution channels: (i) Are coordinated pricing decisions efficient in a context where prices have carry-over effects on demand? (ii) Should firms practice a skimming or a penetration strategy if they choose to coordinate or to decentralize their activities? To answer these questions, we consider a differential game that takes place in a bilateral monopoly where the past retail prices paid by consumers contribute to the building of a reference price. The latter is used by consumers as a benchmark to evaluate the value of the product, and by firms to decide whether to adopt a skimming or a penetration strategy.

We then compute and compare strategies, total channel profits and individual profits under vertical integration and decentralization at steady state and along the optimal time-paths. One of our main findings states that, for some values of the initial reference price, there is a time interval where channel decentralization performs better than coordination. During this transition period, at least one of the channel members could be tempted to end his cooperation, especially if he is not farsighted and if there are no binding agreements with the other channel partners.

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1. Introduction

Many studies have investigated the issue of pricing in marketing channels by taking into account the interactions between their different members and their impact on channel members strategies and profits. The seminal work of [Jeuland and Shugan \(1983\)](#) was one of the first studies to demonstrate the benefits of vertical integration (i.e. cooperation or coordination) with respect to channel decentralization for channel members and consumers. This study triggered a subsequent work in the field of game-theoretic modeling in distribution channels. With some exceptions, most of these studies examined the interactions between channel members in a static environment. By doing so, they ignored the fact that some marketing variables also have long-term effects that could be

damaging to demand in the long run. Promotional activities are an example of such variables. Despite the increase in short-run sales after price-promotional activities, their long-term impact is not always positive, as “frequent price reductions and deals may serve to increase consumer resistance to choosing a brand when it is sold at a regular price” as reported in [Krishnamurthi, Mazumdar, and Raj \(1992\)](#) (see also [Kalyanaram and Winer \(1995\)](#)). This seriously brings into question whether some of the results on the efficiency of static pricing decisions in coordinated distribution channels still hold if we adopt a dynamic perspective when examining this issue.

Indeed, the immediate impact of price on demand is negative and is captured in most of the traditional economic-theory models used in channel literature. When we introduce into these models the carry-over impact of pricing strategies, we take into account the fact that the past prices paid by consumers contribute to the building of a reference price. The latter is compared to the actual retail price, which leads to a judgment about the observed retail price (cheap or expensive) and a perception of the value of the product (gain or loss) that affects consumers purchase decisions. Hence, the low retail prices associated to channel coordination in the static setting are not necessarily an optimal solution if we consider their long-term effects because they result in lower reference prices and consequently enhance consumers' perception of a “loss” when they have to pay for the product at the regular price ([Nicolau, 2013](#)).

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This means that firms should make pricing decisions based not only on the immediate (negative) impact of prices on demand, but also on their long-term impact.¹ This will also dictate whether firms should practice a skimming or a penetration strategy by pricing the products above or below the consumers' reference price (Völckner, 2008). The importance of considering both the immediate and long-term effects of prices increases in a channel's context where channel members pricing decisions and profits are interdependent. Indeed, the efficiency of vertical integration, as suggested in the static channels literature, should be reexamined along the whole planning horizon, as one of its implications is a decrease of retail prices, and consequently, a decrease of reference prices and an increase of consumers' perception of a price surcharge when the retail price is compared with a low reference price.

Zaccour (2006) criticized the static models used in the game-theoretic channels' literature for not being able to "capture the whole picture". Taking into account the dynamic aspects of the market is not only a way to introduce a more realistic feature into these models but it is also a managerial requirement to make strategic decisions. According to Weisstein, Monroe, and Kukar-Kinney (2013), dynamic pricing is becoming a prevalent practice in the marketplace, especially in the online retailing, where advances in technology are helping retailers to adjust their prices almost instantaneously.

By considering a dynamic perspective in the study of distribution channels, we take into account the fact that channel members do not interact only once, but could develop or put an end to their partnership during the planning horizon depending on whether there are incentives or barriers to channel coordination. Hence, we allow channel members to deviate from their initial behavior at any point in time. This situation could occur in real-life situations, especially if the different channel members do not act in a farsighted manner or have any binding agreement with the other partners.

In this paper, we use the paradigm of differential games to investigate the issue of pricing when we bring in its dynamic effects on consumer behavior in the channels' literature. We consider a manufacturer and a retailer (i.e. a bilateral monopoly) that fix the transfer and the retail prices respectively, and consider that the evolution of retail prices contributes to the building of a reference price. We study a two-player differential game with one state variable (the reference price) and analyze two scenarios depending on the channel structure. In a first scenario (channel decentralization) each channel member (manufacturer/retailer) has one control variable (transfer/retail price). In a second scenario (vertical integration), the unique decision maker (the channel owner) has a unique control variable (the retail price). We compute channel members' strategies and profits at the steady state and along the optimal time-paths under the scenarios of vertical integration and channel decentralization. By comparing the results, we provide answers to the following questions:

- What pricing strategies should firms adopt under vertical integration and decentralization when their decisions have long-term effects?
- Are coordinated pricing strategies always more efficient than uncoordinated strategies?

- Which dynamic pricing strategy (among skimming and penetration) should firms adopt?

A firm setting its prices above consumers' reference price then reducing this price as time goes by practices a skimming strategy. The opposite situation corresponds to a price penetration strategy. In this case, the firm fixes a low retail price when the product is introduced in the market in order to capture a larger market base and increases its price later on (Dean, 1969). The practice of one of these dynamic pricing strategies has a direct impact on consumers' perception of gains or losses and on firm's profits during the planning horizon. Indeed, a firm practicing a skimming (penetration) strategy has a reduced (higher) demand at the introductory stage, but its high (low) prices contribute to the building of a higher (lower) reference price, which allows consumers to perceive a gain (loss) when prices stabilize at the steady state, resulting in a higher (lower) demand at that stage.

Hence, the adoption of a particular dynamic pricing strategy by firms should be affected not only by the initial reference price in consumers' minds, but also by the channel's structure as the latter has a direct impact on the product's retail prices. One of the questions addressed in this paper investigates which strategy among skimming or penetration should firms adopt whether they choose to coordinate or not their decisions (i.e. under vertical integration versus decentralization).

Our paper is structured in the following manner. In Section 2, we provide a brief literature review on the issue of pricing in marketing channels. In Section 3, we present the dynamic model to study this topic. Section 4 gives the main analytical results and the numerical simulations, and Section 5 provides the conclusion.

2. Literature review

The impact of the distribution channel's structure on channel members pricing decisions and profits is a topic that has interested many researchers in the areas of marketing and operations research. One of the key findings in this literature states that the highest channel's profit is reached when the channel members coordinate their decisions as if the channel was vertically integrated (Jeuland & Shugan, 1983). This efficiency is explained by the absence of double marginalization (Spengler, 1950). Indeed, the profit margin of a vertically integrated channel is lower than the sum of the individual margins fixed by the decentralized institutions, resulting in lower retail prices, higher demand, and a higher consumer surplus (Jeuland & Shugan, 1983).

These findings were examined later on by different authors who tested if they still hold under different pricing schemes and competitive channel structures (See Ingene, Taboubi, & Zaccour, 2012). However, most of this literature is based on static models that ignored the carry-over effects of prices on channel members strategies and profits. These carry-over effects have been considered in the behavioral pricing literature (Monroe, 1979; Dodds, Monroe, & Grewal, 1991) which relies on the Adaption Level theory (Helson, 1964) to explain how consumers react to price information. According to this theory, the past retail prices observed by consumers in their shopping experiences create adaptation levels, called internal reference prices and consumers' purchase decisions are determined by the discrepancy between the current levels of prices and the reference prices (Monroe, 1979; Fibich, Gavious, & Lowengart, 2003). The Transaction Utility theory (Thaler, 1985) provides an additional perspective on the behavioral reaction of consumers to price information. It states that consumers do some mental accounting when they compare the retail prices of products to their internal reference prices. These comparisons result in a perceived sacrifice or loss (deal, or gain) if they buy the product

¹ According to Popescu and Wu (2007), managers who ignore the long-term effects of their pricing strategies can lose revenues. Nasiry and Popescu (2011) provide the example of Apple with its iTunes store to illustrate the importance of considering the carry-over effects of prices in pricing strategy. Apple used to sell digital songs for a low price, which, for a long time, was set at 99 cents. When the company decided to raise its prices to \$1.29, the drop in sales was higher than expected. These lost sales are explained by the fact that the 99 cents that consumers used to pay for these songs became a reference price in their minds, and the new price was perceived as very high compared to this new benchmark.

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