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Price competition in retailing: The importance of the price density function

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ABSTRACT

Focusing on two determinant aspects of retail competition, prices and catchment area, this paper aims to specifically investigate the importance of the relative price density function. We answer such questions as whether it pays for a store to offer more low-priced items in a given category than its close competitors and whether a retailer should have a consistent assortment in terms of price tier frequency across all categories. To tackle these issues, we use a store-level panel database provided by IRI covering 34 categories and 150 stores in one province.

1. Introduction

How many products should a retailer stock for each of the price levels of its assortment? This issue is critical and has received considerable attention in the assortment planning literature. Building on this literature, this paper aims to specifically investigate the relative price density function (PDF) and its impact on sales.

The price density function captures the number of Stock-Keeping Units (SKUs) a store offers per price tiers in a given category of products. It is computed using a kernel estimator and provides a holistic view of the store's pricing strategy. Every pricing decision, either local (regarding one or few items) or global (product-line strategy), impacts the PDF. Thus, by carefully estimating the PDF, and integrating it in a sales model, we are able to assess the effectiveness of a wide range of pricing strategies. We may for example investigate whether a retailer should have a consistent assortment in terms of price tier frequency across all of its categories. Furthermore, comparing this PDF to the PDFs of neighbor stores (leading to the *relative* price density function) allows us to investigate pricing strategies in a spatial competition framework. We answer such questions as whether it pays for a store to offer more low-priced items in a given category than its close competitors.

The advantage of using such a thorough indicator as the PDF derives from the fact that retail pricing literature is very rich and diverse in its methodological approaches and, sometimes, its results. For example, focusing on product overlap and using a series of experiments, Gourville and Moon (2004) provide the "recommendation for a higher-end retailer to carry *at least* some [low-priced] products that overlap with its primary competitors" (p. 34). Yet, emphasizing the role of multiple store shopping behavior and using data from a consumer panel, Vroegrijk et al. (2013) find that the best strategy for supermarkets facing Hard-Discount entry is to focus on high-priced products which diminishes comparisons and foster complementarity between competitors. The analysis of the relative price density function can help accommodate for these divergent recommendations, and even provide more precise results for each price tiers and product categories. By introducing the PDF as a research and managerial tool, this paper intends to provide an integrated framework for the comparison of strategic pricing decisions and their effectiveness in terms of store and category sales.

To tackle these issues, we use a store-level panel database provided by IRI covering 34 categories and 150 stores in one province. We identify close competitors for each store and we compute the PDF for each assortment (store × week × category), along with other variables of interest. These density functions are then compared to the competitors', providing a unique view of the relative price offerings for each store and each price level. The comparison between the store's and the competitors' PDFs allows us to pinpoint which price tiers are the most frequent in a given store's assortment relative to its competitors (Fig. 1). Using a mixed-modeling approach, we calculate the impact of several aspects of the PDF on euro sales at the store and category levels.

The rest of the paper is arranged as follows. First, we review the

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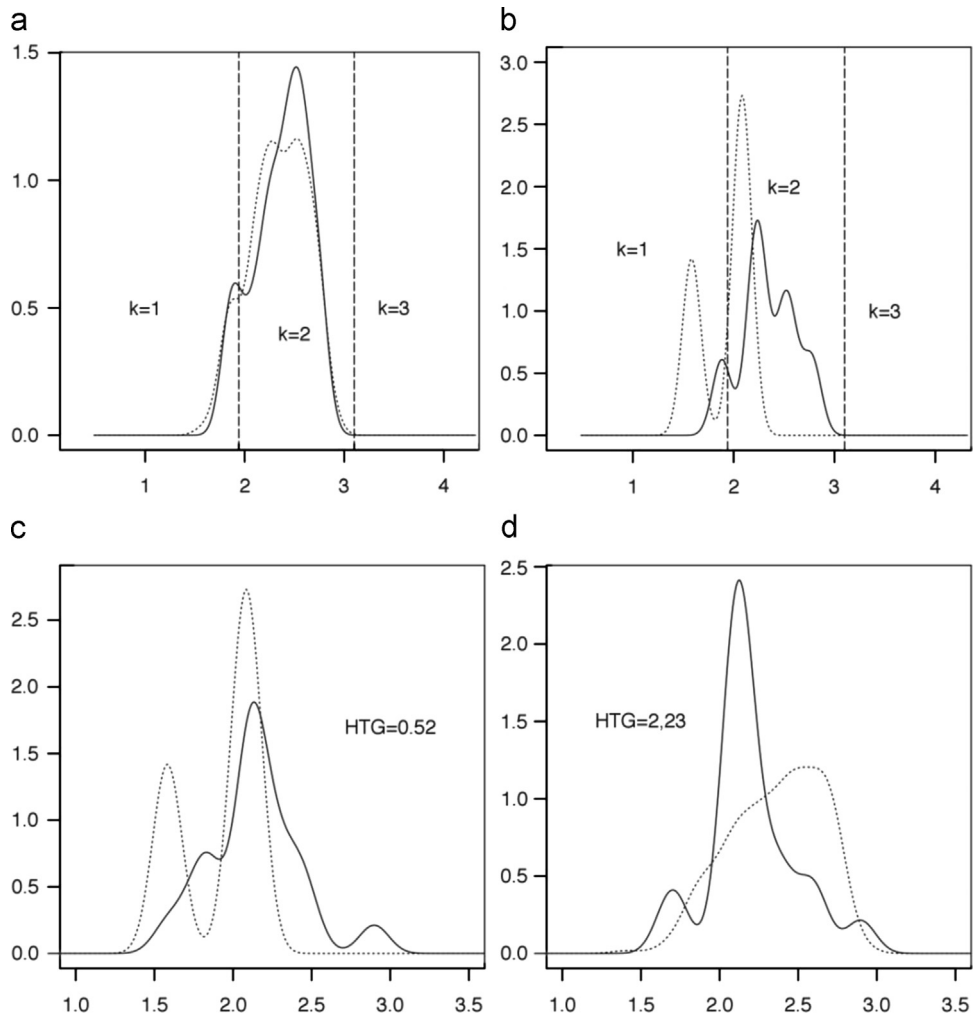

Fig. 1. Relative PDFs of four assortments in the minced meat category.

relevant literature to emphasize how retail pricing impacts the density function of prices within assortments. Second, we describe the construction of the relative PDF. Third, we present the sales model incorporating price density and its results. Fourth, we discuss the theoretical and managerial implications of our research. Finally, we conclude the paper.

2. Background

Price competition in retailing has been an active field of research for decades. The strong interest stems from the fact that prices are an important driver of store choice for consumers (Amine and Cadenat, 2003). Pricing research incorporates several streams, ranging from price setting to the price perception of items, assortments, and stores. As could be expected, those researches provide a vast diversity of guidelines for retailers to set their prices. We posit that the use of such a tool as the PDF is a way to confront results that can be divergent. We note however that this diversity may also be explained by non-price related factors.

2.1. Diversity of pricing guidelines

Since the seminal work of Petroshius and Monroe (1987) on price lines and intervals, a vast diversity of guidelines has been proposed to retailers by academic researchers in order to tackle assortment pricing issues.

Many, but not all, focus on the importance of low prices and their role on store price image formation, store attractiveness, and higher sales. For example, Desmet and Le Nagard (2005) and Zielke (2006), using consumer surveys, find that the presence of products in the lower price range has a beneficial impact on store price image. Similarly, Alba et al. (1994, 1999) assess the positive impact of the frequency and magnitude of price advantage on store price image. In a more competitive approach, Gourville and Moon (2004) show that even a high-end retailer can benefit from having low-priced items whose prices are aligned with those of competitors in order to signal the retailer's price fairness. Hence, even if a retailer stocks many items in the higher price tier, the retailer may choose to offer low-priced items as well. Those three seemingly convergent guidelines on low prices differ however on a fundamental aspect that is central to our analysis: the number of products the retailer should stock in the lower price range. Desmet and Le Nagard (2005) and Zielke (2006) provide no clear quantity, for Alba et al. (1994, 1999), the more the better, and for Gourville and Moon (2004), one or a few is enough. One of the metric we derive from the analysis of the PDF covers precisely this aspect. Hence, using the relative PDF, we are able to fill this gap and easily determine whether and how much a retailer does offer more or fewer low prices than its competitors, and whether this strategy pays off in terms of sales.

Even if not precise, a consensus exists on low prices strategy; this