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Retail pricing decisions and product category competitive structure

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ABSTRACT

This study addresses the use of demand forecasting techniques by retailers to support their decision making. Specifically, the authors propose a pricing decision support model for retailers to estimate optimal prices, whose output depends on the configuration of a supporting measurement model. The measurement model is a demand function that relates sales and prices within the category; optimal prices are those whose effects on demand and retail margins maximize the category's profitability. This investigation focuses particularly on the role of competitive structure, such that the authors consider two types of price competition asymmetries for demand forecasting: those depending on the brand (differential price effects) and those dealing with demand for competing brands (cross-price effects). By explicitly modeling competitive asymmetries in the demand function that underlies the decision support model, the authors assess implications for pricing decisions, sales, and profitability. The empirical application of the model to store-level, aggregated scanner data for two frequently purchased categories reveals the impact of an asymmetric competitive structure on demand forecasting and optimal pricing decisions. Furthermore, this article quantifies the costs of ignoring asymmetric competitive interactions in retailers' decision making.

1. Introduction

The increasing power of retailers has become more apparent in the form of greater autonomy in their final pricing decisions. These autonomous retailer pricing decisions constitute a key element of marketing channel performance that can determine the profits of manufacturers [18], especially if the decisions come from large-scale retailers [20]. Therefore, it should come as no surprise that retailing research has focused primarily on category management and the favorable consequences of this management strategy compared with brand-centered management [45]. Authors cite the key role of category management in achieving more profitable retail pricing structures [3], yet no studies investigate the extent to which these positive consequences might depend on the implementation of the category management. Despite the importance of assessing and understanding the competitive structure of product categories for successful category management, prior research offers little empirical support. This article addresses this gap by analyzing how a greater understanding of the competitive structure within a product category may improve retail pricing decisions in the context of category management approaches.

A full understanding of any competitive structure requires the analysis of competition asymmetries [8]; we consider the role of two types of price competition asymmetries. First, the impact of variations in a brand's price may differ depending on the brand, in that the price changes of different brands likely affect demand with greater or lesser intensity. Second, the impact of variations in a brand's price may differ across the various levels of demand for competing brands. The higher the substitutability of two brands, the greater the impact of their price changes. If retailers explicitly consider these asymmetries in their category pricing decision making, they may make more precise predictions about market responses to their pricing decisions and thereby improve their profitability.

We propose a pricing decision-making model, based on aggregated scanner data in the context of frequently purchased categories. In this model, the optimal prices are those whose effects on demand and retail margins maximize the category's profitability; the output therefore depends on the configuration of a supporting measurement model, in which the demand function relates sales and prices within the category. Our proposed model explicitly details competitive asymmetries in the demand function, which indicates their implications for pricing decisions and thus for sales and profitability.

Various authors have considered the problem of pricing decision optimization for retailers [10,21,25,29,31,39,42]. In Table 1, we summarize the key contributions of these studies for our investigation. Although all these approaches recognize that the optimal prices for a product category maximize its expected profits, few consider competitive asymmetries explicitly when they specify the relationship

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Table 1
Previous research contributions regarding the category pricing optimization decision.

Research	Retail context	Data (level of aggregation)	Explicit asymmetric effects?
Reibstein and Gatignon [31]	Grocery retailing	Store-level aggregated data. Two stores.	Yes
Vilcassim and Chintagunta [42]	Grocery retailing	Household-level data	No
Kim, Blattberg, and Rossi [21]	Grocery retailing	Household-level data	No
Tellis and Zufryden [39]	Grocery retailing	Household-level data	No
Montgomery [29]	Grocery retailing	Store-level aggregated data. One store	Yes
Chintagunta [10]	Grocery retailing	Store-level aggregated data. Several stores	No
Mantrala et al. [25]	Automotive aftermarket retailing	Store-level aggregated data. Several stores.	No

Notes: Each line corresponds to a brand and represents the effects of price changes across competing brands.

between prices and sales. Rather, the effects they find result from different assumptions about consumer behavior. For example, some studies incorporate latent heterogeneity among consumers [10,21,42], whereas others incorporate latent heterogeneity among stores [25], though in neither case can they isolate the role of competitive asymmetries from other price optimization determinants.

Two studies formalize each brand's demand within a product category as a function of all brand prices to capture competitive asymmetries [29,31], but this procedure is not robust [42], because the model can produce unrealistic solutions, such as infinite or negative prices. To resolve this issue, we incorporate brand demand decomposition into category demand and market share. In other words, the price effect consists of purchase decision and brand choice decision effects; the latter reflect the competitive interaction among brands. Using market share models that possess logical consistency adds robustness to the demand function and enables more explicit modeling of the asymmetric price effects [12].

This article's contribution is twofold. First, we investigate the role of competitive structure in successful retail category management, especially the extent to which understanding competitive structures within a product category improves the profitability of the whole category as a result of improved pricing decisions. Our proposed model decomposes the price optimization problem of retailers into its relevant components (i.e., decision model, overall category demand model, and within-category market share model) and offers a way to understand the effects of the competitive structure (i.e., competitive asymmetries between brands). Second, our empirical application shows that the proposed decision support model can operate with the input of readily available, store-level, aggregated scanner data; we also provide a numerical example in which the consideration of competitive asymmetries changes the retailer's optimal decisions. Although our approach is based on assumptions subject to some limitations, it improves researchers' and practitioners' ability to make pricing decisions within a product category by accounting for competitive asymmetries. Our goal is to demonstrate that incorporating asymmetry in cross-price effects alters a retailer's pricing decision.

2. Modeling proposal

Our proposed model attempts to determine optimal prices for every brand included in a frequently purchased product category in a retail store. The proposal employs scanner data aggregated to the store-level and assumes that the retailer has information about sales, prices, and other marketing variables for every brand within the product category for a specified sample of time periods.

Of the three possible aggregation levels for scanner data—household, store, and market [17]—most studies focus on the store-level, because of the limited availability of disaggregated scanner data from point-of-sale systems located in retail stores. Information about the purchase history of specific households and consumers is available exclusively for those clients that the retailer can identify, such as through loyalty cards or credit accounts. Using such information can lead to bias though, such as when consumers use several cards or apply them only in specific purchase occasions (e.g., large purchases). Furthermore, the loyalty card consumer group may not represent the store's clients overall. Therefore, an analytical methodology that aims to be replicable for any store at any time and whose estimations and recommendations involve all potential customers of the store requires the use of scanner data aggregated to the store-level.

Our proposed model contains two key elements. First, the decision model provides an objective function, whose optimization determines the optimal prices, and the function depends on the market response to marketing stimuli, such as price. Second, this proposal represents a formalization of the measurement model that captures the relationship.

2.1. Decision model: objective function

A store's objective is to maximize the profit generated by the product category [21,31,39,42]. Profit B_t in period t thus equals the sum of the gross profit generated by each brand N that constitutes the category, minus the fixed costs CF_t for that category. The profit of brand i equals the sold units Q_{it} multiplied by the unitary margin, which is the difference between the unitary price P_{it} and the unitary cost C_{it}. In short,

$$B_t = \left(\sum_{i=1}^{N}(P_{it}-C_{it})\cdot Q_{it}\right)-CF_t \quad (1)$$

The quantity that each brand sells depends on the pricing policy adopted for the category. Although the model focuses on this variable, the quantity sold also can represent a function of other marketing variables managed within a category (e.g., promotions through feature advertising and store displays). The quantity sold depends on other contextual circumstances E_t (e.g., seasonal consumer habits). Modelers therefore must understand sales as an endogenous variable, explained as follows:

$$Q_{it} = f\left(\{P_{it}\}_{i=1}^{N}; E_t\right) \quad (2)$$

Optimal prices maximize the expected profit, as in Eq. (1). These prices do not depend on the fixed costs assumed by the retailer, so modelers can ignore this factor from an operational point of view. Although the retailing sector plays an increasingly important role in setting prices, the manufacturer's restrictions on the retailer's brand price modifications still influence the optimization problem; some national brands impose particularly significant limitations on the retail prices of their products.

In either case, our proposal constitutes a simplified interpretation of the problem, with three primary limitations: First, it assumes a fixed cost structure, but the unitary cost for a brand may depend on sales volume, which can be negotiated with suppliers [39]. Similarly, sales category volume may condition the fixed costs, at least partially. Therefore, we assume that the manufacturer is a strategic player with regard to maximization and that the wholesale price may be restrictive. This assumption is not problematic, because this research attempts to show that incorporating asymmetry in cross-price effects can change the retailer's pricing decision. Second, though the analysis does not include other product categories, complementary and