



An empirical analysis of demand variations and markdown policies for fashion retailers



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ABSTRACT

In this paper, using data from a leading specialty apparel retailer, we empirically examine the determinants of a retailer's dynamic pricing policy and investigate consumer response to price changes (markdowns) throughout a fashion product's selling season using a product diffusion setting. In order to do that, we first develop and estimate a markdown pricing model and a consumer demand model that capture the important characteristics of the fashion apparel market. Next, we use the estimates from these two models to design and simulate four alternative markdown pricing policies to investigate the impact of these different policies on consumer demand and retailer revenues. Our results, in line with the previous literature, show that markdowns implemented early in the season but small in magnitude generate the highest retailer revenues. Our paper not only provides a comprehensive empirical framework for fashion apparel retailers that is easy to implement, but also shows that using this framework will lead to timely decision making and will improve sale and revenue outcomes in the fast paced fashion world.

1. Introduction

Product pricing is one of the hardest challenges firms face today. As Monroe (1990) mentions, "Today's pricing environment demands better, faster, and more frequent pricing decisions than ever before." Dynamic pricing policies, where a product's price changes over time, are widely used in many industries. In the fashion apparel market, for example, products are launched at a retail (full) price, but this price is marked down permanently one or more times until the end of the selling season. We have witnessed a dramatic increase in the frequency and depth of markdowns in the recent years. National Retail Federation (1998) reports that sales at markdown prices as a percentage of sales have increased from 10% to 28% in specialty stores and from 6% to 20% for department stores over a 30-year-period (1967–1997). Pashgian (1988) confirms the increase in the prevalence of markdowns in the apparel market over time and suggests the growing role of fashion as the main driver behind this trend. National Retail Federation (2009) also reports that more than 30% of all sales for department and specialty stores took place at markdown prices in 2009. The considerable growth of markdowns in department and specialty stores can be explained by some special characteristics of the fashion apparel market. First, most (traditional) fashion apparel retailers have their products

produced overseas, and as a result, replenishment lead times are often much larger than the length of the selling season (Soysal and Krishnamurthi, 2012). As a result, the retailer has a single opportunity to order items and cannot replenish its inventory during the selling season. One important exception to this is fast fashion retailers like Zara (Caro and Gallien, 2012), who have constructed their supply chains in a manner that ensures shorter replenishment lead times. Second, fashion apparel products are sold through short selling season. For that reason, they are categorized as seasonal goods or short life cycle goods. At the end of the selling season, the product is discontinued and the remaining inventory is often discarded, donated, or sold at a very low salvage value. Faced with these characteristics, a fashion goods retailer orders a finite supply of each product at the start of the selling season and faces a tradeoff between selling each unit in its inventory at as a high a price as possible and clearing its inventory by the end of the selling season.

Permanent price markdowns are used to generate more demand by invoking consumers to purchase. However, many important questions arise: How do retailers decide whether to reduce the price of a fashion product during the season? In other words, what are the factors that would impact the pricing decisions of a fashion retailer? How do pricing decisions influence the product adoption process? How is the markdown policy related to consumer demand from the product adoption

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angle, and more importantly, how is that related to the retailers' revenue? The answers to these questions would have practical managerial implications and would guide the fashion apparel retailers on design and implementation of successful markdown pricing policies.

In this paper, first we identify the important determinants of a price markdown policy for a fashion retailer to capture the firm's behavior. Next, to measure consumer behavior, we evaluate the impact of the markdown policy on consumer demand and the retailers' revenue through the product adoption process. Our focus in this study is on modeling permanent price cuts, rather than temporary store promotions. We develop models for consumer demand and depth of markdown (as a number between zero and one) for a fashion retailer. The markdown pricing model is estimated based on the technique developed by [Arellano and Bond \(1991\)](#) using the Generalized Method of Moments (GMM). The estimation results of the markdown model provide a quantitative description of markdown policy of the focal retailer. For the consumer demand model, which controls for fixed effects for each fashion coat, we examine the adoption process of the fashion product and how it might be influenced by changes in the retailer's markdown policy.

The general idea of the adoption process in our consumer demand model is close to [Kalish \(1985\)](#). Our model relates the varying market potential and accumulated sales of all the previous periods with sales of the current period. In our consumer demand model, we assume that, at the beginning of each period during the fashion season, the consumer has the option to adopt (purchase) the product at the current period, adopt it at later periods in the season, or not adopt the product at all. When the product is adopted, the adopter is out of the market for the rest of the season; i.e., we make the single purchase assumption. We are interested in investigating how the adoption process (purchase of the product) is influenced by a price markdown, in other words, how the diffusion and adoption of the product are related to price markdowns in the concept of fashion goods. Our intuition is that, after each markdown, the buyer's market potential changes in the sense that consumers with lower willingness to pay (the higher price sensitive segment of the market) who have not been part of the market potential to that point would join the market and add to the market potential to make their adoption decision.

The consumer demand model is estimated with product fixed effects and allows for correlation between residuals. Our findings show that consumer demand is expected to be higher when product availability increases and after the item is marked down at least once. We also find evidence that time left until the end of the fashion season positively impacts consumer demand.

Based on our model estimation results, in addition to the current markdown policy used by the retailer, four other markdown policies are simulated and evaluated: "Constant Rate & Early-start Markdown Policy," "Deep-start Markdown," "Late-start Markdown Policy," and "Early-start & not Deep in the Late Periods Policy." The criteria used for evaluating and comparing the simulated policies are predicted consumer demand and the level of revenue generated by each. These simulated policies are compared with the retailer's current markdown policy as the benchmark. The estimated demand and revenue outcomes show that, among the four simulated markdown policies studied, the "Constant Rate & Early-start Markdown Policy" generates the largest revenue levels, while the "Deep Start Markdown Policy" generates the largest demand figures.

The main contributions of our study are the following: (1) we develop and estimate a reduced form markdown-pricing model and determine the factors that impact a fashion retailer's pricing policy. (2) We develop a reduced form consumer demand model by making the connection between revenue management and product adoption literatures and estimate the model for fashion products using the product diffusion/adoption literature. Through that setting, we find how the markdown policy impacts the product adoption process. (3) By simulating four new markdown policies and calculating their resulting

demand and revenue levels based on our consumer demand model, we propose characteristics of a better markdown policy for the fashion retailer. (4) Our reduced form models are faster and easier to implement compared with the other methods suggested in the literature. This would make them applicable to the practitioners' needs. (5) Our findings have useful managerial implications and provide guidelines for setting markdown pricing strategies.

While there is an extensive literature on methods for developing markdown policies, our literature review shows that there is relatively little published information about consumer response to markdowns of fashion items and that there has also been little quantitative study of the factors that motivate retailers to set markdowns for fashion items. We will address both of these issues. Because developing an optimal policy that could be used would require information on constraints faced by the retailer that we do not have, and would also not be straightforward, we decided not to pursue this option. Instead, we believe that our simulations will provide valuable insights into the applicability of different policies.

The remainder of the paper is organized as follows: literature review; forming the models and hypotheses; presenting the data, estimations and results; simulating different markdown policies, discussing the results and managerial implications; concluding remarks; and further research areas.

2. Literature review

Having defined the product adoption (i.e., purchase) through a diffusion model from one side and studying price variations and markdowns for fashion goods from the other side, we reviewed two main streams of literature for this research. The first stream of literature is related to markdowns, inter-temporal pricing, and revenue management and the second one is related to studies of diffusion models and product adoption processes with varying market potential and prices. In [Table 1](#), we include a categorized list of relevant works done within each stream of literature and present what our work offers within each stream. In [Table 2](#), we summarize how we reconcile these two streams and where our paper stands at a higher level with respect to the major works within them. A brief discussion of positioning follows [Table 2](#) accompanied by a detailed discussion of the relevant literature for each stream, their connection with the current work, and main contributions of the paper.

A large portion of the literature on markdown pricing emphasizes theoretical work. Models of optimal markdown and pricing can be found in marketing, operations management, and economics literature. In marketing literature, [Rao \(1984\)](#) presents a set of pricing models in marketing. He reviews the static and dynamic models of pricing, focusing on new products through their life cycle. In operations and revenue management, [Elmaghraby and Keskinocak \(2003\)](#) review the literature of dynamic pricing in presence of inventory considerations.

Early work by economists focused on explaining the rationale for markdown pricing. [Lazear \(1984\)](#), who emphasized the role of pricing in providing information about consumer demand, showed that fashion goods usually have lower initial prices and sharper rates of price markdowns compared with storable goods. In one of the first papers focusing on the pricing of fashion products, [Pashigian \(1988\)](#) developed a theory of clearance pricing and examined historical trends in markdowns for fashion goods. Following up on this study, [Pashigian and Bowen \(1991\)](#) identified demand uncertainty and price discrimination to be the two most plausible explanations for observed markdowns.

There are many analytical studies of optimal markdown policies for short life cycle goods, which include fashion goods. [Bitran and Mondschein \(1997\)](#) identified inventory level and time on the shelf to be two important factors in defining an optimal markdown strategy and derived a model of optimal markdown pricing. We incorporate those two variables into our consumer demand model. [Gallego and van Ryzin \(1994\)](#) studied a model in which the arrival rate of the buyers depends

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