

Package size and price discrimination in the paper towel market [☆]

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Abstract

Estimates from a structural model of consumer behavior and firm conduct are used to decompose the extent to which quantity discounts for paper towels are consistent with second degree price discrimination as opposed to cost differences across sizes. Counterfactual exercises assuming that firms offer only one package size or charge uniform prices across sizes indicate that competition in the multi-roll package size segment results in increased consumer surplus and lower prices for all consumers.

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1. Introduction

Several consumer goods markets are characterized by brands that simultaneously offer different sized packages of the same product. These otherwise identical goods are often sold at different unit-prices — typically at volume discounts. While it is easy to find examples of products with prices that are nonlinear, attributing nonlinearities in observed prices to the presence of second-degree price discrimination is much more difficult. Invariably, cost-side explanations could also account for the nonlinearity in prices — for example, one may argue that larger package sizes can be produced at lower unit cost, or that inventory, transaction, or restocking costs are lower for larger sized packages. Much attention, therefore, has been

given to econometrically identifying price discrimination when observed prices are nonlinear. The flavor of this work has been to determine whether observed nonlinearities in prices can be explained by variables that capture the ability of firms to price discriminate — e.g., the number of firms, the availability of competing products, and demographic patterns. Costs are controlled for either by including cost-related variables in the regression or by providing an explanation of why costs (in theory or in the data) cannot explain the observed price nonlinearities.

I examine the effects of multiple package sizes in the paper towel industry by estimating a structural model of consumer demand and firm pricing behavior using readily available aggregate level data. I am able to use the model to decompose the unit-price of each product into a markup term (that reflects demand and competitive conditions) and a cost term. The extent to which price discrimination is driving the differences in unit-prices of the same underlying good is captured by differences in the unit-markups of small and large sized products of the same brand. These estimates are then used to determine the proportion of the observed within-brand unit-price

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variation across different package sizes that is cost-driven, and how much is consistent with price discrimination. I find that between 35 and 45% of the observed unit-price variation is consistent with price discrimination.

Estimating a structural model has the additional advantage of permitting the researcher to predict market performance under counterfactual behavioral assumptions. I explore two such assumptions: (1) each brand may only offer its small size; and, (2) each brand must charge a uniform unit-price for all its sizes. In the counterfactual in which only the small size is offered, the model predicts modest price increases and a decrease in consumer surplus on average of about \$100,000 to \$140,000 per million consumers per quarter (due mainly to consumers forced to substitute away from the large size). In the uniform pricing counterfactual, the model predicts modest price decreases for small packages and a significant price increase for large packages with a negligible decrease in consumer surplus.

In Section 2, I discuss the data used in this paper and provide some background on the paper towel industry. In Section 3, I describe the role of package size in consumer products and discuss how offering multiple package sizes enables firms to sort between different types of consumers. Section 4 reviews methods that have been used to analyze price discrimination in settings with multiple firms. Section 5 presents the model of consumer behavior, and Section 6 presents the model of firm pricing behavior used to identify costs. Section 7 describes the estimation procedure, Section 8 provides results, and Section 9 concludes.

2. Data

I use data collected by Information Resources Incorporated (IRI) from 64 cities and eight quarters (1997–1998). I observe price and volume measures for each of the paper towels in my sample. This gives me 512 potential observations on each product.¹ IRI collects its data from grocery stores² with sales greater than \$2 million per year (IRI says this comprises more than 80% of grocery sales in each city). The quantity measure for each city is imputed (by IRI) from the sample.

About ninety “brands”³ of paper towels and several more generic and private label brands (hereafter, “un-

branded” paper towels) were marketed in the United States during the study period, 1997–1998. Of these, I consider eleven to be “major brands” in that they enjoyed an average market share⁴ of at least 2.5%, conditional on being offered. Ten of these brands belong to the four dominant firms in this industry: Fort James Corporation (the result of an August 1997 merger of Fort Howard Corporation and James River Corporation); Georgia Pacific Corporation; Kimberly Clark Corporation (which merged with Scott Paper in July 1995); and Procter and Gamble. The other major brand, Marcal, is sold by Marcal Paper Mills, Inc. These eleven brands account for approximately three-quarters of paper towel purchases while private labels and generics account for approximately one-quarter of paper towel purchases. Of the eleven paper towel brands in the sample, nine offer multiple package sizes — though not in all markets in which they are sold. For reasons that are discussed below, I aggregate package sizes into two groups — *small*, or one-roll packages, and *large*, or multi-roll packages.

At least two groups, *Consumer Reports* and *The Women's Consumer Foundation, Inc.*, have performed and published the results of experiments that ranked towel brands according to their absorbency and strength when wet. There seems to be some agreement that these are the relevant dimensions of product quality for paper towels, and so it would be useful to have these measures for the brands in the sample. I was unable to use the results from these tests, however, because they did not test all of the brands in my sample and they provided only discrete measures of absorbency and strength (poor to excellent). I, therefore, attempted to replicate the experiments performed by *Consumer Reports* in order to gain continuous measures of absorbency and wet strength for all the brands in the sample. These experiments were performed under the supervision of Robert Pufahl, Ph.D. Chemistry. We performed double-blind tests on all eleven paper towel brands. The absorbency (per square foot) measure was obtained by filling a beaker with water and weighing it with an electronic scale to the nearest milligram. We then submerged the towel in the beaker, letting it saturate,

⁴ Market shares for good j , in city c , at time t are defined as:

$$\frac{\text{vol}_{j,c,t}}{\text{Max}_{\tau} \sum_j \text{vol}_{j,c,\tau}}$$

where volume is measured in 100's of square feet. That is, in the denominator is the largest market volume in the city, regardless of time period. The rationale for this measure is discussed at length below.

¹ In fact, not all brands are sold in all cities. In addition, many package sizes are sold only in a few cities.

² My dataset excludes large “clubs” like *Sam's Club* and *Costco*, as well as convenience stores like *7-Eleven* and *White Hen*.

³ A brand refers to the name borne by the product. Thus, *Bounty* and *Bounty Medleys* are different brands, but all sizes of *Bounty* are a single brand.

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