

Modeling Dependencies in Brand Choice Outcomes Across Complementary Categories

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Abstract

We build an econometric model of a household's contemporaneous brand choice outcomes in complementary product categories. This model explicitly captures cross-category dependencies in brand choice outcomes of a household. Such dependencies have not been modeled in existing multi-category demand models.

Our model accommodates cross-category dependencies that arise on account of three component effects: (1) *complementarity* due to the additional utility that a household derives from the joint purchase of brands in complementary categories, (2) *marketing spillovers* due to the effects of brands' prices in one category affecting the households' latent utilities for brands in the complementary category, (3) *unobserved dependencies* due to correlations in households' latent utilities for brands across categories.

We estimate our proposed multi-category brand choice model using scanner panel data on cake mix and frosting categories. We find that *complementarity* accounts for the vast majority of the estimated cross-category effects in demand. We also find that as much as 55 percent of the total retail profit impact of price promotions arise on account of *brand-level* (focus of our study), as opposed to *category-level* (focus of previous studies), dependencies in household demand. Finally, we propose an easily interpretable visual representation – Largess and Free-Ride Plot – of cross-category price elasticities that summarizes the differential abilities of brands to influence, or be influenced by, brands in the complementary category.

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Introduction

Many consumer packaged goods categories are dominated – in terms of the number of available products, as well as their relative market shares – by a few national brands. Some of these national brand manufacturers have long product lines in multiple categories. For example, General Mills manufactures a wide range of product categories, including bottled juice, cake mix, cereal, dinner kits, fruit snacks, salad dressing, frosting, pasta, pasta sauce, and popcorn. Similarly Kraft produces bacon, cake mix, cheese, coffee, cookies, dinner kits, frozen pizza, and many

more. Both manufacturers use umbrella brand names across these categories. Tables 1a and 1b list the popular umbrella brands of both companies. For example, *Betty Crocker* and *Pillsbury* are popular umbrella names used by General Mills across a large number of product categories, while *Kraft* and *Oscar Mayer* are popular umbrella names used by Kraft Foods across many categories. Within a manufacturer's product mix, it is not necessary that demands for its products – even products that bear the same umbrella brand name – are correlated. For example, weekly demand for Betty Crocker brownies may be independent of weekly demand for Betty Crocker mashed potatoes. However, to the extent that cake mix and frosting are complements in consumption (i.e., together provide greater utility to consumers than the sum of the individual utilities), the weekly demand for Betty Crocker cake mix may be positively correlated with the weekly demand for Betty Crocker frosting. In other words, lowering the price of Betty Crocker cake mix may not only increase its own

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Table 1a
Umbrella brands of General Mills (as of 2009).

| Brand | Product categories |
|----------------|--|
| Betty Crocker | Pasta, rice, brownies, mashed potatoes, cake mix, frosting, pancake mix |
| Pillsbury | Biscuits, dinner rolls, cookies, pastries, cake mix, frosting, sweet rolls |
| Totino | Frozen pizza, sandwich, Mexican rolls |
| Old El Paso | Dinner kits, taco shells, seasonings |
| Cascadian Farm | Frozen fruits, frozen vegetables, RTE cereals, snack bars, fruit spread |

sales, but also increase the sales of Betty Crocker frosting at the same time. As the manufacturer of a wide product mix, with umbrella brand names sometimes straddling seemingly related product categories (such as cake mix and frosting), General Mills has, therefore, a strategic need to understand correlations in market demand for its product offerings across product categories. Such an understanding will assist General Mills in better coordinating its pricing and promotion decisions for its product lines in related categories.

While understanding demand inter-relationships between its product offerings (bearing the same umbrella brand name) in related product categories, it is also necessary for General Mills to understand its brands' demand inter-relationships with other brands in those categories. For example, the Pillsbury brand competes with the Betty Crocker brand in both categories. However, the Pillsbury brand is also owned by General Mills. On the other hand, Aurora Foods, the main competitor of General Mills in the cake mix and frosting categories, markets products under the umbrella brand name of *Duncan Hines* in both categories. This means that on the one hand, while General Mills may want to prevent the cannibalization of Betty Crocker sales by Pillsbury sales (since both are company-owned brands), on the other hand, General Mills may want to steal sales from the competing Duncan Hines brand in one or both categories. The strategy space for General Mills's marketing mix, therefore, expands in an interesting manner on account of not only owning multiple brand names (i.e., Betty Crocker and Pillsbury), but also being present in two related product categories. In order to facilitate strategic decision-making of firms in such situations, multi-category brand choice models must be estimated using customers' longitudinal brand choices in complementary product categories.

There exist two research streams in the marketing literature that propose and estimate multi-category brand choice models

Table 1b
Umbrella brands of Kraft Foods (as of 2009).

| Brand | Product categories |
|-------------|---|
| Kool-Aid | Frozen treat, powdered soft drinks, ready to drink |
| SnackWell | Cookies, crackers |
| Kraft | Cheese, macaroni and cheese, barbecue sauce, dips, mayo, caramels, salad dressing |
| Oscar Mayer | Bacon, cold cuts, hot dogs |
| Post | Cereal bars, RTE cereals |
| Velveeta | Cheese, macaroni and cheese |
| DiGiorno | Frozen pizza, pastas and sauce, cheese |

(see Russell et al. (1999) and Seetharaman et al. (2005) for thorough reviews of multi-category models). The first stream – Ainslie and Rossi (1998), Kim, Srinivasan, and Wilcox (1999), Seetharaman, Ainslie, and Chintagunta (1999), Iyengar, Ansari, and Gupta (2003), and Duvvuri, Ansari, and Gupta (2007) – deals with the estimation of multi-category brand choice models to study whether households have similar marketing mix sensitivities across categories. The second stream – Russell and Kamakura (1997), Erdem (1998), Erdem and Winer (1999), Singh, Hansen, and Gupta (2005), and Hansen, Singh, and Chintagunta (2006) – deals with the estimation of multi-category brand choice models that allow a household's brand preferences to be correlated across categories. In models under both streams, conditional on a household's preference parameters (i.e., marketing mix sensitivities and brand preferences) in the product categories, the household's contemporaneous brand choice outcomes in the categories are assumed to be uncorrelated. Such models ignore contemporaneous cross-category dependencies that would arise on account of product categories being consumption complements. Our focus in this paper is to propose and estimate a multi-category brand choice model that is appropriate for modeling households' contemporaneous brand choices in complementary categories, and to demonstrate its application.

There exists a literature on modeling cross-category dependencies in households' category-level buying behavior in complementary product categories. For example, Manchanda, Ansari, and Gupta (1999) and MAG (1999) henceforth, estimate a multivariate probit (MVP) model to explain household-level contemporaneous incidence outcomes in the cake mix and frosting categories. They allow for two types of cross-category dependencies in their multi-category incidence model: (1) *marketing spillovers* due to the effects of one category's price affecting the household's latent utility for the complementary category and (2) *unobserved dependencies* due to correlations in households' latent utilities for the two categories. Niraj, Padmanabhan, and Seetharaman (2008) and NPS (2008) henceforth, estimate a bivariate logit (BVL) model, first used in Marketing by Russell and Peterson (2000), to explain household-level contemporaneous incidence outcomes in the bacon and egg categories. They allow for two types of cross-category dependencies in their multi-category incidence model: (1) *marketing spillovers*, as in MAG (1999), and (2) *complementarity* due to the additional utility that a household derives from the joint purchase of the complementary categories. From MAG (1999) and NPS (2008) emerge three underlying components of cross-category dependencies in households' incidence outcomes: (1) *complementarity*, (2) *marketing spillovers*, and (3) *unobserved dependencies*.

While they document strong cross-category dependencies in households' incidence outcomes, both MAG (1999) and NPS (2008) ignore brand choice outcomes in their analyses. Two recent papers – Mehta (2007) and Song and Chintagunta (2007) – address this issue by deriving multi-category models of households' incidence and brand choice outcomes. However, neither of these models accommodates cross-category dependencies in households' brand choice outcomes. Cross-category demand dependencies are modeled only in incidence outcomes (as in

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