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A cross-category investigation into the effects of nine-ending pricing on brand choice

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ABSTRACT

Retailers largely adopt nine-ending prices and these prices have attracted greater attention from researchers in marketing. Despite this increased interest, very few empirical studies have tried to quantify the effects of nine-ending prices on consumer actual behaviors. Those who have studied the behavioral effects of nine-ending prices have produced mixed findings. In this article, we investigated the cross-category effects of nine-ending pricing on consumer brand choice at the SKU level. We distinguished between different types of nine-ending while controlling for the rounded prices and other marketing-mix variables. We conducted our analysis on over 11,000 SKUs in 102 product categories of two (2) grocery retailers. We find that the effects of 99 ending prices on the SKU's category choice are larger in concentrated and promotional categories but smaller in expensive categories. However, their influence on purchase quantity is larger in expensive categories but smaller in concentrated categories.
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1. Introduction

When retailers use nine-ending prices (e.g. 2.99) instead of rounded prices (e.g. 3.00), how does this affect the demand for the individual brand? Nine-ending pricing refers to the use of prices that are below the rounded prices such as 9.99 instead of 10.00 or 399 instead of 400. Underlying the adoption of this pricing policy is the assumption that nine-ending prices have a positive effect on consumption levels and sales. A large number of studies have examined the mechanism by which consumers process nine-ending prices (Schindler, 2006; Thomas and Morwitz, 2005). Notwithstanding its importance and potential benefits, researchers have not clearly established the behavioral and financial implications of nine-ending prices. One stream of studies reports that nine-ending pricing results in greater demand (Schindler and Kibarian, 1996; Holdershaw and Gendall, 1997; Kalyanam and Shively, 1998; Anderson and Simester, 2003; Bizer and Schindler, 2005). Other studies have reported non-significant effect of nine-ending prices or even greater demand effects for rounded prices (Bray and Harris, 2006; Martínez-Ruiz et al., 2006). Furthermore, prior studies have not addressed the contextual limits of the nine-ending pricing. For example, we know little about the category effects of nine-ending pricing. Yet, some product categories may be more appropriate for nine-ending pricing (e.g. expensive categories) than others (e.g. promotional categories). However, because of the lack of studies on how product category characteristics influence the efficacy of nine-ending pricing, this issue remains largely a conjecture. To fill this research gap, we develop a conceptual model that incorporates the effects of nine-ending pricing on brand choice while accounting for the moderating effects of category structure or nature. We cast our model within the economics of information theory (Milgrom and Roberts, 1986; Erdem and Swait, 1998) and propose that nine-ended prices convey information about the product value (Stiving, 2000). However, the ability of nine-ended prices to convey information about product value will depend upon the product category, consistent with prior studies that have shown that consumers' price response varies across categories (Pauwels et al., 2007; Nijs et al., 2007).

2. Research background

2.1. Studies with regard to the cognitive mechanisms of nine-ending pricing

Level theories: level effects focus on cognitive processes (Stiving and Winer, 1997) or the price illusions effects (Holdershaw and Gendall, 1997) that cause customers to underestimate their price perception. Within this theoretical framework, there are different theories such as: (1) consumer round down prices (e.g. $0.99 viewed as $0.90) (Gabor and Granger, 1964; Schindler and Kibarian, 1993), (2) consumers have limited

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memory, which makes the remembering of the leftmost digits easier than the rightmost digits (Brenner and Brenner, 1982), and (3) consumer encoding process goes from left to right, where the former receives more weight than the latter. Different studies have tested these theories. Schindler and Wiman (1989) demonstrated that compared with rounded prices, the corresponding odd- and nine-ending prices produced an impression of greater discount. Holdershaw and Gendall (1997) also used an experiment to estimate the demand curves for six different consumer products (cheese, frozen chicken, chocolate, hair dryers, electric kettles, and blenders). They conclude that five- and nine-ending resulted in greater-than-expected demand. Furthermore, the demand was more sensitive for lower-priced products. However, they found a non-significant difference between the effects of five- and nine-ending prices, suggesting that retailers may use nine endings and benefit from the extra 4 in each sale. Guéguen and Legohérel (2004) report that consumers' attention, which decreases when reading from left to right, leads to partial memorization of the price, and consequently favors the leftmost digit and leads to errors of evaluation of the price. In an experiment, Bizer and Schindler (2005) also found that 99-ending prices gave the impression of more financial resources. They found that respondents thought they could buy significantly more products priced with 99 endings than products with comparable 00-ending prices. Other studies, however, have produced mixed support. Schindler and Kibarian (1996) showed that nine-ending prices did not lead to an increase in the number of purchases. However, they influenced the customers who had already taken the decision to buy by directing their choice toward more expensive products (due to underestimation of the price by the consumer). Stiving and Winer (1997) analyzed demand for canned tuna and yogurt and found conflicting results about the effects of 9-cent price endings as well. Finally, Thomas and Morwitz (2005) showed that consumers sometimes but not always perceive nine-ending prices to be lower than a price one cent higher, specifically when the nine ending causes a change in the leftmost digit.

Image theories: these theories refer to the impact that nine-ending pricing has on the consumer's opinion about the product, the store or competition based on the right-hand digits of the price (Stiving and Winer, 1997). The idea is that nine-ending pricing may signal that the manufacturer/retailer provides the lowest price, which may lead customers to believe that competitors offer a lower value. The empirical evidence is mixed. Schindler and Kibarian (2001) demonstrated that when an item was displayed with a nine-ending price instead of a zero-ending price, consumers judged the product to be "on sale" and were more likely to believe that they could not get a better price, that is lower than the nine-ending price. Gedenk and Sattler (1999) argue that retailers should typically set nine-ending prices, unless they suspect a strong effect of price ending on quality image. Stiving (2000) provided evidence that customer infer that zero-ending implies high quality and nine-ending implies low quality. Those results explain why firms tend to use more round prices for higher quality products. Naipaul and Parsa (2001) explained why consumers associate the zero-ending prices with overall quality and nine-ending prices with overall value. However, when Schindler (1997) analyzed 243 grocery items in six different stores, he found that nine endings were among the higher prices for some items among the six stores. Similar results were found in a study of 120 items among ten retailers (Schindler, 2001), all of which have lead to the so-called 99-meaning paradox (Schindler, 2006).

2.2. Studies with regard to the actual purchase behaviors

It appears from the literature that a very few studies that have concerned the demand effects of nine-ending pricing have yielded mixed insights. On the one hand, a group of studies suggests positive effects of nine-ending prices. For example, Nagle (1987) reports that unit sales for one brand increased by 194 per cent when its price was reduced from 83 cents to 63 cents, but increased by 406 per cent when discounted to 59 cents. A second brand showed a similar effect, with a 65 per cent increase in unit sales when discounted from 89 cents to 71 cents and a 222 per cent increase when discounted to 69 cents. It is difficult to ascribe such an increase to nine-ending prices alone given the substantial decrease in price. Blattberg and Wisniewski (1987), in a working paper, examined the influence of a "nine-ending price" variable on sales of a supermarket chain using scanner data. The influence of nine-ending prices was positive for thirteen (13) of the 21 brands, suggesting that nine-ending effects might differ across brands. Schindler and Kibarian (1996), using a controlled experiment on a direct-mail women's clothing retailer, found a difference in sales of 8% associated with nine-ending prices compared to rounded prices. Kalyanam and Shively (1998) examined the demand effects of price points for coffee, bathroom tissue, margarine, and tuna, and found significant sales and profit spikes for nine-ending prices for these products. More recently, Anderson and Simester (2003) conducted three natural experiments in the mail order catalog industry and found that the use of nine ending increased demand in all the three experiments. On the other hand, some studies have reported non-significant or positive effects of nine-ending prices. Georgoff (1972) conducted an in-store sales experiment for 11 products, by varying prices weekly between 00-ending prices and 98-ending prices (e.g., $7.98). He found no statistically significant sales difference between the two price-ending conditions. In a recent study, Bray and Harris (2006), using UK retailing data, found that the use of round prices increased sales. Martínez-Ruiz et al. (2006) also found that nine-ending prices had no impact on sales. As can be seen, previous studies, using experiments for understanding the nine-ending cognitive mechanisms, have yielded mixed findings. Similarly, studies with regard to the purchase behaviors have produced mixed results. Positive (Anderson and Simester, 2003) and non-significant (Martínez-Ruiz et al., 2006) effects of nine-ending prices have been reported. Similarly, both higher (Bray and Harris, 2006) and lower (Schindler and Kibarian, 1996) effects of rounded prices appear in the extant literature. We believe that one way of conciliating prior studies is to conduct a cross-category analysis of the effects of nine-ending pricing. Indeed, there may be conditions, which favor the achievement of the benefits of nine-ending prices and conditions that hamper its benefits to materialize.

3. Research hypotheses

We are concerned about how nine-ending pricing affects the demand for the individual brand. Because, the nine-ending price is observable only at the stock keeping unit (SKU), we have to develop our hypotheses at the SKU level. Fig. 1 presents the conceptual model for this research. We model the influence of nine-ending pricing on the brand's share of category demand or share of category choice. We define the share of category choice (SCC) as the brand's choice share among the group of consumers who buy the brand during the period under consideration (Pauwels et al., 2002). More specifically, we examine if the use of nine-ended price would capture (at least during that period) a larger share of buyers from the category than the use of a rounded or any other type of price format.

We adopt an information perspective to the nine-ending pricing issue, consistent with the idea that nine-ending prices provide information about the value or the quality of the products

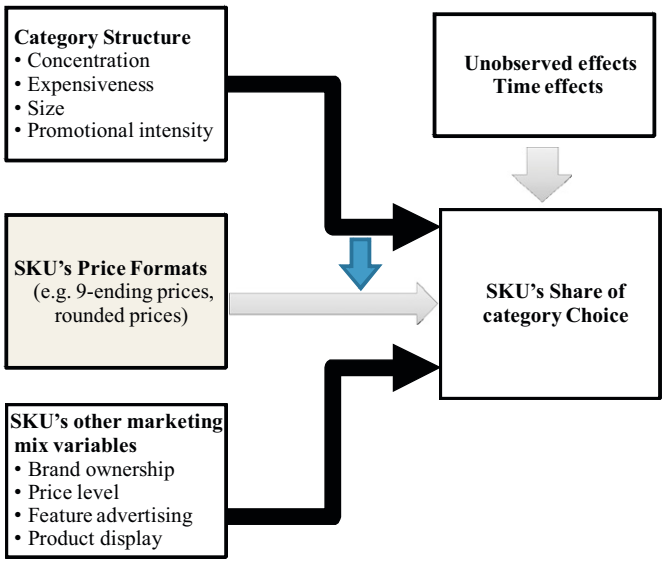

Fig. 1. Conceptual model.

(Stiving, 2000). In other words, they convey a certain product image. Information economics theory (Milgrom and Roberts, 1986) has proven useful in modeling choice situations where the decision maker faces asymmetric information, e.g. on the quality or the value of the product. This theory suggests that under asymmetric information (e.g. when consumers are not sure of the product quality or value), decision makers rely on signals (Spence, 1973). We posit that the same theory should provide indications regarding the role of nine-ending pricing. According to Erdem and Swait (1998), the credibility of the signal is important in influencing customer behaviors. The credibility of the signal decreases the perceived risk and ultimately influences the consumer's expected utility. These authors defined brand credibility as the believability of the product information contained in a brand. Nine-ending prices convey an image of better value about the brand, which should enhance its credibility (i.e. consumers believe in its claims for lower price), reduce the perceived risk and consequently the expected utility from buying the brand. However, consumer confidence in a retailers' nine-ending pricing policy depends upon product categories.

Prior research suggests that consumer price response varies across product categories (Pauwels et al., 2007; Nijs et al. 2007). This implies that sensitivity to nine-ending prices may also vary across product categories depending upon their nature and/or structure. We draw on previous studies on cross-category effects of marketing instruments (Pauwels et al., 2007; Nijs et al. 2007) and consider the following product category characteristics: (1) category concentration, (2) category size, (3) category expensiveness, and (4) category promotional activity. The underlying idea of our research hypotheses is that product category enhances or reduces the credibility of nine-ending prices and consequently their impact on the share of category choice.

Concentration: The degree of concentration should influence the credibility of the signal sent by a nine-ending price. When a product category is fragmented and concentration is low, the degree of rivalry in the category is likely to be more intense. Customers are likely to be more price sensitive, as they can find other supply sources. For example, consumers can find better value from promotions and nine-ending prices are not the only way of obtaining better value. Consequently, the association between nine-ending prices and share of category choice is weaker in more fragmented product categories that are characterized by low concentration. In a concentrated category, consumers have fewer alternatives and the category leaders capture most of the demand. Therefore, concentrated categories should draw consumers' attention to nine-ending prices (which convey image of better value) more than less concentrated categories purchased at the same store. Thus, we hypothesize that:

H1. As the degree of concentration increases, the effects of nine-ending pricing on brand's share of category choice increases.

Category size: The signal of a nine-ending price should be weaker in large categories than in smaller ones. In large product categories, consumers have greater opportunity to find quality and premium products. Large categories are also attractive to competitors and draw significant competitive activity. These conditions should reduce the believability of the claims of a nine-ending price, i.e. lower prices, as customers have more opportunities to find better value given the large number of product categories. In sum, large categories should not draw greater attention to nine-ending prices relative to smaller ones. Consequently, we hypothesize that:

H2. As the category size increases, the impact of nine-ending prices on brand's category choice share decreases.

Category expensiveness: Expensive categories include many premium brands the purchase of which is less likely to be driven by price (Pauwels et al., 2007). However, nine-ending pricing on expensive products may also draw greater consumers' attention to prices compared to the same pricing in less expensive categories purchased at the same store. Consequently, it could engage more consumers to buy the nine-ended product. The rationale is that nine-ending pricing would give the impression that the product is within reach for budget-conscious consumers, which should enhance its credibility. It should have smaller effects in cheaper categories, because most consumers are able to afford products at their regular prices.

H3. As the category expensiveness increases, the impact of nine-ending prices on brand choice increases.

Category promotional intensity: Category promotional frequency increases price volatility (Pauwels et al., 2007) and price sensitivity (Mela et al., 1997; Kopalle et al., 1999). Promotional categories should not draw greater attention to nine-ending prices relative to categories with lower frequency of promotions. The reason is that these categories offer opportunities of obtaining good value. Consequently, the credibility of a nine-ended price decreases as promotional intensity increases. However, in categories with lower frequency of promotions, nine-ended prices should provide an alternative, in terms of good value, to the existing products so that the use of nine-ending price is a credible signal to the consumers. Therefore, we hypothesize that:

H4. As the category promotional intensity increases, the impact of nine-ending pricing on brand choice decreases.

4. Data selection and variable construction

The dataset spans 156 weeks of scanner data provided by MarketingScan, a GFK & Mediatrie company in France. The data are from a test market where panels represent a stratified sample from a city of 151,279 inhabitants. The stores covered account for 95% of the grocery sales in the cities. The panel members also make more than 95% of their purchases at these stores. Stores include hypermarkets and supermarkets. Purchase data are available for a period of 3 years (2004–2006). It is SKU-level

scanner data for 148 product categories representing 12 stores from five (5) chains. The relevant variables include unit sales, retail prices, and promotional activity at the SKU level. Examples of the product categories include beer, cereal, cheese, crackers, dish detergent, juice, laundry detergent, paper towels, shampoos, soaps, soft drinks, toothbrushes, and toothpastes. We aggregate purchases from 1869 households to the SKU level. We excluded 45 product categories because they had few observations. The initially retained dataset covers 12,535 SKUs (from 1942 brands) in 103 product categories.

Following Pauwels et al. (2007), we computed the brand choice measure as follows. First, we determined for each store the category incidence as the total number of panelists who buy in the product category in every week. Then, we determined the brand choice as the share of these consumers buying the SKU. As for the independent variables, we included different price formats with different levels in order to contrast nine-ending prices. We examined primarily the retail shelf prices that end in 9, i.e. the 99-ending prices (e.g. €1.99) and the standard nine-ending prices (e.g. €1.19, €3.29). We excluded the nine-rounded prices (e.g. €9, €19, €29) because they were underrepresented (134 instances). We then defined two variables: $P_{0.99}=1$ if the SKU k has a price level ending in .99 and 0 otherwise, and $P_{\text{standard}}9=1$ if only the last decimal of the price level of SKU k ends in 9 (e.g. €1.19) and 0 if otherwise. To better assess the effects of nine ending, we created other formats such as (1) 95-ending prices (e.g. €1.95), (2) other nine-ending prices (e.g. €1.91 through €1.94, and €1.96 through €1.98), (3) 00-rounded prices (e.g. €2.00), and (4) the other prices (e.g. €1.22, €2.23), which serve as the reference price format. Similarly, we define dummy variables such as $P_{0.95}=1$ if the price level of SKU k ends in .95, $P_{00}=1$ if the price level of SKU k is 00-rounded to 0, and $P_{\text{other}}9=1$ if the SKU has a price level ending in .91/.94 or .96/.98. It appeared that the 95-ending prices were proportionally less adopted. We regrouped the 95-ending prices with the other nine-ending prices.

Then, we examined the distribution of price formats across stores and categories. In Table 1, we report the distribution of price formats across the twelve (12) stores. As can be seen, most of the 99-ending prices appear in stores nos. 1515 and 1976. These two stores also have a great proportion of standard-9 ending prices—respectively 10.03% and 11.6% for stores nos 1515 and 1976 (two other stores have a similar proportion of standard-9 ending prices – 11.3% and 11.25% – but nearly no 99-ending prices). These stores are from two different chains. Store no 1515 is a medium-sized hypermarket while store 1976 is a large hypermarket. Therefore, we focus only on these two stores. Next, we examine the distribution at the category level. We find that nine-ending prices are unevenly distributed across categories, with most of 99-ending prices adopted for water, desserts, butter, and eggs. We excluded all the categories where there is no 99-ending price, leading to 102 product categories for both stores. Finally, we retained only the SKUs with 10 observations to be sure that we examine products with a certain number of buyers. This is important, as our dependent variable is a relative measure in the product category.

To account for the influence of other marketing actions, we included brand ownership (1=store brand, and 0=national brand), regular SKU price, feature advertising (1=yes and 0=no), and product display (1=yes and 0=no). We computed category concentration, size, expensiveness, promotional intensity as follows (Pauwels et al., 2007). Concentration is based on the Herfindahl and Hirschman index (HHI)—we added the squares of the market shares of all brands in the category. The higher the HHI for a specific category, the more sales are concentrated within a small number of brands. As for category Size, we used the number of SKUs in the category in every store and period. We computed the category expensiveness as the weighted average of the actual prices of the brands in the category. Category feature advertising intensity was measured as the average of feature advertising frequency of the brands in the category. Category display activity is operationalized as the average of product display frequency of the brands in the category.

5. Approach to the testing of hypotheses

The essence of our study is to look for possible effects of nine-ending prices on the choice of a focal brand's SKU. Therefore, an important starting point is to develop a demand model that relates a SKU's choice share to its price formats. Our analysis takes place at the stock keeping unit (SKU) level. The reason is that this is where we can identify the actual price (with decimals) paid by the consumer. We do not estimate a household-level choice model for several reasons. First, the product categories in our data have tens and sometimes hundreds of SKUs. This poses a challenge to estimate traditional consumer choice models because these models will estimate a very large number of parameters. Prior research has resorted to different approaches, such as reducing the number of product-specific parameters by discarding the least frequently bought SKUs (Fader et al., 1992; Siddarth et al., 1995), excluding all the consumers who bought these SKUs (Chintagunta, 1993), aggregating the level of analysis to a higher level (Bucklin and Gupta, 1992), or developing a composite product called "other products" (Chiang, 1991; Erdem and Keane, 1996). All these approaches may cause a bias in the

Table 1
Distribution of price formats across the 12 stores.

Stores	Price formats					Total
	Other price formats (e.g. €1.22, €2.32)	99-ending prices (e.g. €1.99)	Standard-nine-ending prices (e.g. €1.69)	Other nine-ending prices (e.g. €1.91, €1.95)	Rounded prices (e.g. €2.00)	
1235	92,249	12	13,763	13,625	1984	121,633
1453	11,342	20	1969	1660	246	15,237
1492	18,940	3	2866	2874	391	25,074
1515	87,171	**1548**	11,375	12,923	348	113,365
1789	60,234	12	6720	8605	1312	76,883
1914	10,080	0	1452	1162	228	12,922
1940	14,103	18	2080	1985	286	18,472
1976	55,893	**743**	8755	8939	928	75,258
1998	104,871	38	15,494	15,090	2221	137,714
2000	64,876	4	7461	8883	1458	82,682
Total	519,759	2398	71,935	75,746	9402	**679,240**

parameters as they do not estimate demand for all SKUs or exclude some consumers. Our model includes almost all the available SKUs and excludes only a very marginal number of them. This allows us to estimate the effects of nine-ending prices on the demand for all SKUs. This is important for a comprehensive assessment of the effects of nine-ending prices on brand choice.

Eq. (1) shows the basic model linking brand choice (share of buyers) with different predictors:

$$\ln(y_{kbcst}) = \beta_{kc} + \sum_{p=1}^{P} \beta_{kc,p}^{P} P_{kbcst,p} + \sum_{q=1}^{Q} \beta_{kc,q}^{X} X_{kbcst,q} + \sum_{m=1}^{M-1} \beta_{m}^{S} S_m + \sum_{d=1}^{D-1} \beta_{d}^{W} W_d + \varepsilon_{kbcst} \quad (1)$$

where $\ln y_{kbcst}$ is the logarithmic value of the share of households buying SKU k of brand b in category c store s in week t, P_{kbcst} is a vector of different price format variables (e.g. rounded prices, and nine-ending prices). The term β^P captures the influence of these price formats. The term X_{kbcst} refers to the other marketing-mix variables defined for each SKU of each brand b in each category c store s and week t the influence of which is captured with β^X. We control for store-specific effects through store dummy variables (S) and for weekly effects through weekly dummies. ε_{kcst} is the error term.

Unobserved heterogeneity: We control for the unobserved effects across SKUs and categories. Furthermore, although we allow for unobserved brand-level and category-level effects, many variables such as price, price formats, feature, and display might still differ across brands even if we control for unobserved heterogeneity in the intercept. Similarly, given that we are interested in cross-category differences in the effects of price formats, it is quite justified that we model our parameters as random coefficients with a mean effect and random components at both the brand and the category levels. We do it by means of a factor-analytic structure with latent factors on the random coefficients (e.g. Kamakura and Kang, 2007):

$$\beta_{kc}^{cons} = \beta^{cons} + \gamma^{cons} F_k + \lambda^{cons} F_c + \delta_{kc}^{cons} \quad (2)$$

$$\beta_{kc}^{pred} = \beta^{pred} + \gamma^{pred} F_k + \lambda^{pred} F_c + \delta_{kc}^{pred} \quad (3)$$

Here β^{cons} is the average share of households that buy SKU k, and β^{pred} is the mean effect of the predictor. F_k is a vector of latent factor scores for SKU k, accounting for unobserved SKU heterogeneity. γ is a vector of loadings on the heterogeneity factor at the SKU level. F_c is a vector of factor scores for category c, accounting for unobserved category heterogeneity, and λ is a vector of loadings on the heterogeneity factor at the category level. The terms δ_{kc} and ξ_{kc} are i.i.d. random errors. The mean coefficients (β) provide an assessment of the average effect of the predictor, after accounting for the differences in response across SKUs and categories. A positive coefficient means a one-unit increase in the independent variable has the effect of increasing the SKU category share. γ and λ are deviations from the average. The size of the loadings determines the amount of unobserved heterogeneity. The larger the loading, the more unobserved is the heterogeneity.

By combining Eqs. (2) and (3) with Eq. (1), we obtain the model for SKU category choice share:

$$\ln(y_{kbcst}) = \beta^{cons} + \gamma^{cons} F_k + \lambda^{cons} F_c + \delta_{kc}^{cons} + \sum_{p=1}^{P} \beta_{p}^{P} P_{kbcst,p} + \sum_{p=1}^{P} \gamma_{p}^{Q} F_k P_{kbcst,q} + \sum_{p=1}^{P} \lambda_{p}^{P} F_c P_{kbcst,p} + \sum_{p=1}^{P} \delta_{kc,p}^{P} P_{kbcst,p} + \sum_{q=1}^{Q} \beta_{q}^{X} X_{kcst,q} + \sum_{q=1}^{Q} \gamma_{p}^{X} F_k X_{kcst,q} + \sum_{q=1}^{Q} \lambda_{q}^{X} F_c X_{kcst,q} + \sum_{q=1}^{Q} \delta_{kc,q}^{X} X_{kcst,q} + \sum_{m=1}^{M-1} \beta_{m}^{S} S_m + \sum_{d=1}^{D-1} \beta_{d}^{W} W_d + \varepsilon_{kbcst} \quad (5)$$

We relate the category latent scores to category characteristics as follows:

$$F_c = \tau + \sum_{r=1}^{R} \tau_r Z_{cst,r} + \varsigma_c \quad (6)$$

where τ is the intercept, $Z_{cs,r}$ is the vector of the category characteristics ($r=1,\ldots,R$) for each store s and time t, τ_r is the influence of the rth characteristic, and ς_c is the error term. Eqs. (5) and (6) can be estimated simultaneously by substituting Eq. (6) into (5).

Endogeneity: Endogeneity in nine-ending prices may arise when the retailer chooses to promote less-performing brands during some periods (e.g. holiday weeks) by changing the price from a rounded to nine ending. However, endogeneity is likely to be less important, as we use weekly data (Danaher et al., 2008). By including the weekly dummies, we should be able to control these seasonal demand effects (fixed- and week-specific events), which might induce a correlation between price policy variables and the model error.

6. Results

Nine ending prices and their adoption: We began by examining the differences between the price formats in terms of price levels. We conducted an analysis of variance, which reveals that, on average, there are differences in terms of price means between the different price formats ($F=248.31$, $p=0.0000$). Except for the "99-ending prices" and the "other prices", which are not statistically different (Bonferroni value $=-0.068$, $p=0.255$), we find that the rounded prices are more expensive than the 99-ending prices (0.752, $p=0.000$), the standard 9 prices (0.401, $p=0.000$) or the other nine-ending prices (0.571, $p=0.000$). There is no nine-ending paradox regarding these retailers, as the 99-ending prices are adopted primarily for products that are also less expensive. Nevertheless, we make this conclusion by analyzing two stores only. This raises the problem of its generalizability. To provide further support to this claim, we compared the average of the 99-ending prices across all the stores. We excluded stores 1492 and 2000, which have less than 10 products sold with a 99-ending price format. Table 2 reports the means of the 99-ending prices for each analyzed store. The results of the analysis of variance indicate that there are differences across these stores (F (6; 2384)$=525.46$, $p=0.0000$). The Bonferroni tests, comparing the raw means with the column means, show that store 1998 (a hypermarket) tends to use 99-ending prices on expensive SKUs compared to store 1515 (12.247, $p<0.0001$) or store 1976 (11.963, $p<0.001$). This suggests that the so-called 99-meaning paradox (Schindler, 2006) is a store-specific phenomenon. Indeed, we find that there is no discrepancy between the low-price meaning communicated to consumers by the 99 ending and their adoption for low-priced products in stores 1515 and 1976. However, we find that there is such a discrepancy in store 1998, for example, where the 99-ending prices are adopted for products that are relatively more expensive. One of the reasons why these stores differ in their adoption of the 99-ending prices may be their different market positions. Indeed, stores 1515 and 1976 clearly have a low-price positioning in this market. Although the average price of products is not always

Table 2
One-way ANOVA results for comparison of 99-ending price means, by store.

Stores			**Mean**			**Std. Dev.**		**Freq.**
1235 (Hypermarket, chain 1)			10.073333			5.3505876		12
1453 (Supermarket, chain 2)			1.84			1.631112		20
1515 (Hypermarket, chain 4)			2.0061499			1.3973371		1548
1789 (Hypermarket, chain 3)			14.073333			4.9443877		12
1940 (Supermarket, chain 2)			2.4344444			2.280924		18
1976 (Hypermarket, Chain 2)			2.2901346			1.5136709		743
1998 (Hypermarket, chain 1)			14.253158			3.8812384		38
Total			2.4186906			2.4745097		2391
Bonferroni tests								
Row mean-|Col mean	1235	1453	1492	1515	1789	1940	1976	1998
1453	−8.233							
	0.000							
1492	0.917	9.150						
	1.000	0.000						
1515	−8.067	0.166	−8.984					
	0.000	1.000	0.000					
1789	**4.000**	**12.233**	3.083	**12.067**				
	0.000	**0.000**	0.106	**0.000**				
1940	−7.639	0.594	−8.556	0.428	−11.639			
	0.000	1.000	0.000	1.000	0.000			
1976	−7.783	0.450	−8.700	**0.284**	−11.783	−0.144		
	0.000	1.000	0.000	**0.003**	0.000	1.000		
1998	**4.180**	**12.413**	**3.263**	**12.247**	0.180	**11.819**	**11.963**	
	0.000	**0.000**	**0.026**	**0.000**	1.000	**0.000**	**0.000**	
2000	1.917	10.150	1.000	**9.984**	−2.083	9.556	9.700	−2.263
	1.000	0.000	1.000	**0.000**	0.887	0.000	0.000	0.265

lower than that of their competitors, these stores use various means (e.g. promotions including nine-ending prices, and loyalty cards benefits) to influence consumers' perceptions of prices. This can be seen in their differences in terms of price image.[1] We conducted an ANOVA test that appeared to be significant ($F=83.028$, $p<0.0001$). The results reported in Table 3 show that stores 1515 and 1976 have better price image than store 1998 for example. We speculate that part of the differences in the adoption of 99-ending prices results from the fact that stores 1515 and 1976 have low-price image and use 99-ending prices as a support for their value image. Store 1998, for example, which has a poorer image, probably uses 99-ending prices on expensive products to convey the impression of lower prices. This remains an assumption that needs to be tested.

Next, we examined in which categories retailers are most likely to adopt nine-ending prices. The results are reported in Table 4. We find that, compared to the rounded prices, the two chains are less likely to use 99-ending prices in expensive categories (-0.227, $p=0.000$), reflecting the fact 99-ending prices convey an image of value for money not an image of quality (Stiving, 2000). However, the likelihood of adopting a 99-ending price is greater in promotional (feature advertising) categories (2.847, $p=0.000$). In these categories, consumers tend to be more price sensitive and consequently the use of psychological pricing mechanisms is more effective in these categories compared with the less promotional categories. We also observed that the number of times a 99-ending price is used in a week is positively correlated with the number of brands promoted in a week (0.67), meaning that the 99-ending price is used as promotional technique. Finally, rounded prices are more likely to be adopted in expensive categories compared to all the other price formats. This can be observed from the negative coefficients for "category expensiveness" that appears in Table 4. This is in line with the view that they convey an image of quality (Stiving, 2000).

Table 3
Multiple comparisons for price image across different stores.

(*I*) Store	(*J*) Store	Mean difference (*I*–*J*)	Std. error	Sig.
1515	1235	.19960	.02356	.000
	1453	.06534	.03659	1.000
	1492	.03062	.03033	1.000
	1789	.38167	.02610	.000
	1940	.20008	.02871	.000
	1976	−.10356	.02517	.003
	1998	**.12620**	**.02318**	**.000**
	2000	.38464	.02330	.000
1976	1235	.30317	.02271	.000
	1453	.16890	.03606	.000
	1492	.13418	.02968	.000
	1515	**.10356**	**.02517**	**.003**
	1789	.48523	.02534	.000
	1940	.30364	.02802	.000
	1998	**.22976**	**.02232**	**.000**
	2000	.48820	.02245	.000
1998	1235	.07340	.02049	.023
	1453	−.06087	.03470	1.000
	1492	−.09559	.02802	.043
	1515	−.12620	.02318	.000
	1789	.25547	.02337	.000
	1940	.07388	.02625	.323
	1976	−.22976	.02232	.000
	2000	.25844	.02020	.000

[1] We do have some survey data from the same market research company. Every January households receive a questionnaire about store image. Some of the items concern the price (or economic) image of the store. They are: (1) this store has low regular prices, (2) store flyers are attractive, (3) the loyalty program benefits (e.g. price reductions, coupons, etc.) are attractive, and (4) sales promotion from this store are interesting. These items load on the same factor and can be named "price or economic image".

Table 4
Multinomial regression results linking category characteristics and price format adoption.

Price formats		Coef.	Z	$P>z$
Other prices	Category expensiveness	−0.172	−10.380	0.000
	Category feature ad intensity	0.508	0.860	0.391
	Category display intensity	−0.249	−0.730	0.467
	Category size	−0.002	−4.350	0.000
	Concentration	0.200	0.570	0.568
	Store dummy (1976 vs. 1515)	−1.418	−22.140	0.000
	Intercept	5.521	35.640	0.000
99-ending prices	Category expensiveness	−0.227	−8.140	0.000
	Category feature ad intensity	2.847	4.120	0.000
	Category display intensity	−0.095	−0.220	0.827
	Category size	−0.003	−4.520	0.000
	Concentration	0.707	1.610	0.106
	Store dummy (1976 vs. 1515)	−1.734	−22.020	0.000
	Intercept	1.270	5.790	0.000
Standard nine-ending prices	Category expensiveness	−0.105	−6.100	0.000
	Category feature ad intensity	0.199	0.330	0.744
	Category display intensity	−0.300	−0.850	0.393
	Category size	−0.003	−5.710	0.000
	Concentration	0.215	0.600	0.552
	Store dummy (1976 vs. 1515)	−1.259	−19.240	0.000
	Intercept	3.356	20.870	0.000
The other nine-ending prices (e.g. €1.91)	Category expensiveness	−0.135	−7.770	0.000
	Category feature ad intensity	0.098	0.160	0.873
	Category display intensity	−0.678	−1.920	0.054
	Category size	−0.002	−4.940	0.000
	Concentration	0.277	0.770	0.442
	Store dummy (1976 vs. 1515)	−1.352	−20.700	0.000
	Intercept	3.609	22.550	0.000

Reference format = rounded prices.

Effects of Nine-ending Prices on SKU's Share of Category Choice: Table 5 reports the estimates of four models.[2]

Model 1 shows that the use of a nine-ending price influences the share of category choice (0.15, $p=0.000$). In other words, SKU demand is greater when the price ends in 99 (e.g. €1.99, €3.99) than when the SKU is sold with a standard price format such as (€1.80, 4.01). The control variables yield interesting results as well. Overall, they have effects that are line with expectations. For example, we can see that brand ownership has a positive coefficient (0.17, $p=0.000$), meaning that the share of category choice, on average, is larger for store brands compared to the national brands. This reflects the fact that these brands tend to be cheaper and now draw a larger number of buyers. Turning to unobserved heterogeneity, we observe that the deviation in the intercept is significant at the category level (0.80, $p=0.000$), meaning that the average share of category choice differs across product categories. The factor loading for the 99-ending price is also significant at the brand level (-0.06, $p=0.000$) and category level (-0.16, $p=0.000$). This means that the effects of 99-ending on category choice differ across brands and product categories while the effect of rounded prices varies across brands only (-0.06, $p=0.01$). The fact that the loading is greater at the category level indicates that the effects of 99-ending prices differ the most across categories than within categories (or between brands).

We estimated a second model (Model 2) where we exclude price formats but include category characteristics. This model has a better fit than Model 1. This means that category structure characteristics alone explain the share of category choice better than price formats alone. Then, we estimated a third model that explains the sources of category heterogeneity in the share of category choice while accounting for the effects of price formats (Model 3). This model has a better fit than Model 2 or 1 as shown by the BIC values. This means that accounting for both category characteristics and price formats explain the data better than each type of variables alone. Finally, we test for the moderating effects of category structure on the effects of price formats (Model 4). The results suggest that Model 4 has a better fit than Model 3. The SKU's category share tends to be larger in expensive (0.07, $p=0.000$) and concentrated (2.78, $p=0.000$) categories because a smaller number of brands account for the category revenues or because consumers have fewer options. The SKU's category share, however, is smaller in promotional categories. Promotional and larger categories permit brand switching. In promotional categories, it is difficult to retain a larger share of customers so that the average number of buyers per SKU is smaller. There are many brands and the number of buyers is shared among the larger number of brands in the category. In terms of SKU-level variables, the direction of the control variables (i.e. brand ownership, price, and promotions) remains the same. However, the effect of 99-ending prices has become marginally significant (at $p<0.10$) while the effects of the other price formats have turned positive. After accounting for the category characteristics, the results show that 99-ending prices:

- have a positive but marginal effect on the SKU's share of category choice in large categories. This is in contrast with H2, which predicted a negative effect;
- increase the share of category choice for the SKUs that are in concentrated categories (0.79, $p=0.000$). This is in line with H1. The use of a 99-ending price makes the SKU appears as an alternative to the exiting category leaders;
- have a negative effect in expensive categories (-0.07, $p=0.000$). This contrasts with our hypothesis (H3). It appears

[2] We realized that controlling for heterogeneity at the brand rather than at the SKU level yielded better results (i.e. more stable parameters). Therefore, heterogeneity in our models was estimated at the brand level not at the SKU level.

Table 5
Estimate results for SKU's share of category choice (weekly dummies not reported for space reasons, # of observations = 188623).

	Model 1			Model 2			Model 3			Model 4		
	Mean effect	Factor loadings at the brand level	Factor loadings at the category level	Mean effect	Factor loadings at the brand level	Factor loadings at the category level	Mean effect	Factor loadings at the brand level	Factor loadings at the category level	Mean effect	Factor loadings at the brand level	Factor loadings at the category level
Intercept	1.74***	0.42***	**0.80***	1.59***	0.44***	0.28***	1.590***	0.449***	**0.27***	1.59***	0.29***	0.47***
	(95.68)	(101.11)	**(164.45)**	(102.03)	(113.34)	(75.18)	(101.96)	(113.95)	**(72.46)**	(101.01)	(80.20)	(102.19)
Control variables												
Store 1976 vs. store 1515	0.51***	–	–	**0.34***	**–**	**–**	0.32***	–	–	0.36***	–	–
	(125.20)			**(101.94)**			(97.38)			(103.00)		
Brand ownership	0.17***	−0.77***	−0.10***	0.09***	−0.03***	−0.06***	0.08***	−0.020***	−0.04***	0.06***	−0.03***	0.00
	(37.16)	(−185.30)	(−21.99)	(24.96)	(−8.08)	(−15.47)	(22.08)	(−5.12)	(−9.90)	(14.20)	(−6.40)	(−0.93)
Price level	−0.03***	0.00*	0.01***	−0.03***	0.00	−0.00***	−0.031***	0.005**	−0.002	−0.03***	−0.01***	−0.01***
	(−19.57)	(2.28)	(6.56)	(−18.76)	(1.84)	(−3.47)	(−20.09)	(3.30)	(−1.35)	(−18.49)	(−4.46)	(−4.04)
Feature advertising	0.06***	0.00	0.01	0.11***	0.02**	0.02***	0.109***	0.023***	0.025***	0.10***	0.01*	0.01
	(8.23)	(0.03)	(0.87)	(19.01)	(2.80)	(3.95)	(18.94)	(3.61)	(4.41)	(17.05)	(2.05)	(1.37)
Product display	0.05***	0.00	−0.02***	0.09***	−0.01***	−0.01**	0.094***	−0.009**	−0.007*	0.09***	−0.02***	−0.02***
	(15.73)	(0.10)	(−6.85)	(32.37)	(−3.28)	(−2.98)	(32.34)	(−2.76)	(−2.36)	(30.32)	(−5.37)	(−5.28)
Price formats												
Nine-ending price	0.15***	−0.06***	−0.16***				0.118***	−0.256***	−0.189***	0.08	**−0.16***	−0.16***
(e.g. €0.99)	(8.73)	(−3.77)	(−8.96)				(8.20)	(−17.22)	(−12.77)	(1.82)	**(−10.17)**	(−8.84)
Standard nine-ending price	0.00	−0.02***	−0.03***				0.015**	−0.027***	0.004	0.01*	0.00	−0.01*
(e.g. €0.79)	(−0.28)	(−3.84)	(−4.32)				(2.94)	(−4.97)	(0.75)	(2.19)	(0.26)	(−2.29)
Other nine-ending price	0.00	0.01	−0.03***				0.011*	−0.019***	−0.005	0.01**	−0.01	−0.02***
(e.g. €1.91)	(0.79)	(0.87)	(−4.57)				(2.19)	(−3.42)	(−0.98)	(2.90)	(−1.29)	(−4.05)
Rounded prices	0.04	−0.06*	−0.03				0.083***	−0.098***	−0.035	0.12***	0.00	−0.08***
(e.g. €2.00)	(1.83)	(−2.58)	(−1.42)				(4.32)	(−4.77)	(−1.73)	(6.22)	(0.10)	(−3.71)
Category heterogeneity												
Category expensiveness				0.07***			0.074***			0.07***		
				(36.83)			(38.05)			(32.58)		
Category feature ad intensity				−0.94***			−0.830***			−0.84***		
				(−26.08)			(−23.37)			(−23.17)		
Category product display intensity				−0.73***			−0.715***			−0.74***		
				(−33.04)			(−33.23)			(−33.65)		
Category size				−0.01***			−0.007***			−0.01***		
				(−237.02)			(−234.78)			(−235.81)		
Category concentration				2.83***			2.825***			2.78***		
				(114.85)			(130.41)			(128.41)		
Category expensiveness × nine-ending price (e.g. €0.99)										−0.07*** (−4.46)		
Category feature ad intensity × nine-ending price (e.g. €0.99)										1.42*** (5.61)		
Category product display intensity × nine-ending price (e.g. €0.99)										0.22 (1.32)		
Category size × nine-ending price (e.g. €0.99)										0.00*** (6.81)		
Category concentration × nine-ending price (e.g. €0.99)										0.79*** (4.26)		
BIC	453,301.959			390,876.57				390,632.15		387,386.13		
# of parameters	77			70				82		87		

* Significant at a 5% level.
** Significant at a 1% level.
*** Significant at a 0.1% level.

Table 6
Estimate results for SKU's purchase quantity (weekly dummies not reported for space reasons).

	Model 1 Zero truncated Poisson regression			Model 2 Zero truncated Poisson regression			Model 3 Zero truncated Poisson regression			Model 4 Zero truncated Poisson regression			Model 5 Zero truncated NB regression		
	Mean effect	Factor loadings at the SKU level	Factor loadings at the category level	Mean effect	Factor loadings at the SKU Level	Factor loadings at the category level	Mean effect	Factor loadings at the SKU Level	Factor loadings at the category level	Mean effect	Factor loadings at the SKU level	Factor loadings at the category level	Mean effect	Factor loadings at the SKU level	Factor loadings at the category level
Intercept	−2.07*** (−34.31)	0.95*** (71.37)	0.64*** (38.05)	−1.14*** (−18.03)	1.06*** (83.00)	0.49*** (27.74)	−1.38*** (−21.95)	1.01*** (83.32)	0.42*** (30.73)	−1.74*** (−27.40)	0.70*** (53.21)	0.87*** (62.71)	−2.88*** (−23.60)	1.32*** (65.45)	0.35*** (15.71)
Control variables															
• Store 1976 vs. Store 1515	0.07*** (5.10)			0.18*** (12.14)			0.18*** (11.48)			0.14*** (10.44)			0.25*** (13.85)		
• Brand ownership	0.57*** (32.60)	−0.06*** (−4.27)	0.19*** (10.18)	0.49*** (27.34)	−0.09*** (−6.35)	0.08*** (4.49)	0.52*** (30.60)	−0.06*** (−4.46)	0.21*** (11.98)	0.44*** (26.78)	0.00 (−0.16)	−0.08*** (−5.15)	0.85*** (37.95)	−0.01 (−0.35)	0.28*** (12.99)
• Price level	0.23*** (98.33)	−0.11*** (−34.84)	0.01** (2.82)	0.27*** (97.05)	−0.11*** (−39.53)	0.02*** (5.52)	0.27*** (106.11)	−0.11*** (−38.17)	0.02*** (8.32)	0.29*** (108.09)	0.01*** (4.94)	−0.12*** (−51.33)	0.46*** (60.83)	−0.23*** (−37.00)	0.03*** (4.43)
• Feature advertising	0.02 (1.71)	−0.02 (−1.12)	0.00 (0.28)	0.05** (3.07)	−0.05** (−2.92)	−0.02 (−1.08)	0.04* (2.40)	−0.03* (−2.11)	−0.02 (−1.23)	0.09*** (6.34)	−0.04** (−2.91)	−0.05*** (−3.85)	0.05** (2.65)	−0.04 (−1.60)	0.00 (0.02)
• Product display	−0.06*** (−4.09)	−0.04* (−2.56)	−0.05*** (−3.68)	−0.05*** (−3.48)	−0.02 (−1.61)	−0.03 (−1.92)	−0.05** (−3.31)	−0.02 (−1.47)	−0.03 (−1.94)	−0.03* (−2.02)	−0.04** (−2.70)	−0.02 (−1.29)	−0.06*** (−3.21)	−0.03 (−1.79)	−0.03* (−2.09)
Price formats															
• Nine-ending price (e.g. €0.99)	0.63*** (15.07)	−0.34*** (−8.07)	−0.40*** (−9.41)				0.55*** (13.01)	−0.41*** (−9.60)	−0.26*** (−6.31)	0.82*** (6.21)	−0.39*** (−8.66)	−0.40*** (−9.11)	0.46* (2.46)	−0.44*** (−7.39)	−0.11 (−1.82)
• Standard nine-ending price (e.g. €0.79)	0.59*** (33.92)	0.25*** (13.23)	0.09*** (4.81)				0.55*** (31.30)	0.13*** (6.86)	−0.14*** (−7.30)	0.53*** (30.29)	−0.06*** (−3.49)	0.13*** (7.64)	0.73*** (27.31)	0.23*** (8.41)	−0.04 (−1.51)
• Other nine-ending price (e.g. €1.91)	−0.09*** (−3.77)	0.08*** (3.01)	0.04 (1.50)				−0.01 (−0.26)	0.12*** (4.77)	0.04 (1.37)	−0.14*** (−5.78)	0.04 (1.39)	0.00 (−0.17)	−0.03 (−0.87)	0.17*** (5.04)	−0.03 (−0.94)
• Rounded prices (e.g. €2.00)	0.62*** (10.98)	0.09 (1.50)	−0.16** (−2.66)				0.52*** (8.53)	−0.16* (−2.53)	−0.25*** (−4.09)	0.47*** (7.39)	−0.13* (−2.01)	−0.28*** (−4.94)	0.60*** (6.45)	−0.13 (−1.23)	−0.17 (−1.93)
Category heterogeneity															
• Category expensiveness				−0.37*** (−36.50)			−0.35*** (−34.76)			−0.31*** (−27.75)			−0.65*** (−43.43)		
• Category feature ad intensity				0.87*** (6.67)			0.88*** (6.97)			0.14 (1.02)			0.84*** (4.70)		
• Category product display intensity				0.16 (1.79)			0.18* (2.01)			−0.05 (−0.58)			0.15 (1.29)		
• Category size				0.00*** (10.08)			0.00*** (12.74)			0.00*** (8.63)			0.00*** (12.65)		
• Category concentration				0.98*** (14.22)			0.91*** (10.90)			1.13*** (16.48)			1.45*** (14.36)		
• Category expensiveness × nine-ending price (e.g. €0.99)										−0.03 (−0.49)			0.16* (1.96)		
• Category feature ad intensity × nine-ending price (e.g. €0.99)										0.00 (−0.01)			−0.64 (−0.72)		
• Category product display intensity × nine-ending price (e.g. €0.99)										−0.61 (−1.07)			−1.10 (−1.43)		

• Category size × nine-ending price (e.g. €0.99)				0.00 (−0.28)	0.00* (2.11)
• Category concentration × nine-ending price (e.g. €0.99)				−0.70 (−1.67)	−1.44* (−2.11)
BIC	133,381.73	133,631.13	132,122.71	131,483.58	128,391.60
Number of parameters	76.00	69	81	86.00	87.00

* Significant at a 5% level.
** Significant at a 1% level.
*** Significant at a 0.1% level.

that the use of a 99-ending would send a negative signal to potential buyers about the product quality; and

- have a larger effect on promotional categories, i.e. categories that feature-advertise the most. This is in contrast with H4. This means that in these categories the 99-ending is used to convey a signal that the product is really cheaper.

Additional Analysis: the effects of nine-ending prices on purchase quantity: It is possible that the nine-ending prices do not attract many shoppers to the SKU but lead the few consumers who do come to the SKU to buy a greater number of units. In such a case, we may observe a greater effect of 99-ending prices on purchase quantity. We use the negative binomial model, a generalization of the Poisson model in which the assumption of equal mean and variance is relaxed (Cameron and Trivedi, 1998). Table 6 reports the results obtained after estimating the effects of nine-ending prices on purchase quantity. In line with Table 5, we estimate different models and retain the one yielding the lowest BIC value.

It appears that the zero truncated negative binomial regression model with random coefficients (i.e. Model 6) fits the data better than its equivalent Poisson specification. We can see that 99-ending pricing increases the rate of purchase (0.46, $p<0.001$) and this effect significantly varies across brands. The standard nine-standard prices (e.g. €0.79) also have a positive effect on purchase quantity, which also differs across brands (0.23, $p<0.001$). The rounded prices have a greater effect on purchase quantity than the 99-ending prices (0.60, $p<0.001$). This coefficient does not differ across brands or categories. Although the two types of prices (rounded versus 99- and standard nine-ending prices) have positive effects, we believe that these positive effects reflect two different things. A positive impact of 99-ending prices reflects the fact that they convey an impression of cheapness while rounded prices convey an image of quality. The standard nine-ending prices tend to stand in between. Control variables provide some interesting results as well. For example, price level is associated with a higher purchase rate (0.46, $p<0.001$) but it depends upon the brand that is purchased (-0.23, $p<0.001$) and in some extent across categories (0.03, $p<0.001$). This means that the effect of price certainly depends upon the brand equity. Product display has a negative association with purchase quantity (-0.06, $p<0.001$). This does not mean that consumers buy fewer units. Rather, this has to do with the fact that product display in France generally uses the "bonus pack" technique. With this technique, the consumer is given more of the product with the same price or sometimes a lower price. Looking at the category structure variables that explain basic heterogeneity (in the average purchase quantity), we can see that consumers buy fewer units in expensive categories probably due to higher prices (-0.65, $p<0.001$). However, they tend to buy more units in categories with intensive feature advertising activity (0.84, $p<0.001$) thanks to the lower prices. Purchase quantity is also greater in concentrated categories (1.45, $p<0.001$) as consumers have fewer options and have to share their purchases across a few brands and their variants.

Turning to the moderating effects of category structure, it appears that the influence of 99-ending prices on purchase quantity is greater in expensive categories (0.16, $p<0.05$). This means that in expensive categories, a 99-ending price may not attract more buyers but makes the existing consumers buy fewer units of the 99-ending SKU, as it gives the impression that the product is more affordable. However, the effect of 99-ending prices on purchase quantity is smaller in concentrated categories (-1.44, $p<0.05$). This means that nine-ending prices attract

more shoppers in concentrated categories but they do not incite consumers to buy more units. This may reflect the fact that the average purchase quantity is already high in concentrated categories so that the incremental number of units is lower.

7. Conclusion

Discussion: In this article, we investigated the effects of nine-ending pricing on brand choice. We distinguished between different types of nine-ending, while controlling for the rounded prices and other marketing-mix variables, and examined the extent to which category structure moderates the impact of nine-ending prices. We conducted our empirical analysis on over 100 product categories.

We found that retailers tend to adopt 99-ending prices and rounded prices in specific categories. The likelihood of finding a 99-ending price is greater in highly promotional categories. The reason we suspect is that the retailers use a 99-ending price as a promotional technique as indeed there is a positive correlation between the use of 99-ending price and the number of products promoted in a given week. We also find that a rounded price is most of the time used in expensive categories. It appears that these retailers' practices are consistent with Stiving's (2000) argument that nine-ending is used to infer an image of good value (low quality) while rounded prices are used by consumers to infer high quality. In addition, we find that the so-called 99-meaning paradox (Schindler, 2006), i.e. low-price meaning is communicated to consumers by the 99 ending, is a store-specific phenomenon. That is while some stores adopt 99-ending pricing for low-priced products, others use 99-ending prices for products that are relatively more expensive. Therefore, future research should address the issue of why firms differ in their adoption of 99-ending pricing.

We shed new light on a recent debate with regard to the effects of nine-ending prices on consumer demand in grocery stores (e.g. Bray and Harris, 2006; Martínez-Ruiz et al., 2006; Schindler and Kibarian, 1996). We find that nine-ending prices do not influence SKU choice per se. Their influence depends upon the product category structure. In other words, it is possible to find a non-significant effect if one does not control the category structure or if the study concerns just one product category. More specifically, we find that the effects of 99-ending prices will depend upon whether the product is in (a) a concentrated product category, (b) a promotional category, or (c) in an expensive product category.

99-ending prices attract more buyers in concentrated categories. This is in line with our proposition that in concentrated categories consumers have fewer opportunities. Despite the fact that the average share of category choice is higher in concentrated categories, the use of a 99-ending price was able to draw additional buyers to the SKU. In concentrated categories, the degree of rivalry in the category is less intense. Customers are less likely to find cheaper products, as the category leaders capture most of the demand and can set higher prices. By using a 99-ending price on a product, the retailer gives the impression to the buyers that the product is more affordable. Such a signal would be less effective in categories low in concentration, as consumers can find better value from competing alternatives. However, when we look at the purchase quantity effects, we find that 99-ending prices tend to reduce the purchase rate in concentrated categories. This finding suggests that 99-ending prices in concentrated categories do attract additional buyers, as they offer alternatives to the existing products, but consumers do not buy more units, probably because the product prices in concentrated categories remain relatively higher compared to prices in more competitive categories. Said differently, our results suggest that in a competitive category, a 99-ending price would not attract more buyers to the product. However, it could make the current buyers increase the number of products they buy, as they would have the impression that the product has become cheaper. An alternative explanation is that the use of 99-ending prices in concentrated categories increases the choice share for an SKU. However, they attract a small number of additional buyers to the SKU, i.e. those who otherwise would not have bought, who also are likely to buy fewer units than the regular consumer for that SKU. As a result, average purchase quantity decreases.[3]

Contrary to expectations, we find that 99-ending prices are less effective in expensive categories. This result is consistent with prior research that indicates that expensive categories include many premium brands the purchase of which is less likely to be driven by price (Pauwels et al., 2007). It may be that the 99-ending price does not offer a large price discount to engage more additional consumers in expensive products. By using 99-ending prices, the retailer may, instead, send a negative signal to some of the buyers about the product quality. However, the relationship becomes a little complex when one looks at the effects on the purchase quantity. It appears that, although on average consumers buy fewer units from expensive categories, the use of a 99-ending price can still increase the purchase quantity among the consumers who do buy a 99-ended price product in expensive categories. While there are not new buyers coming to the category thanks to the 99-ending prices, this price format does influence the remaining buyers in the category to increase their purchase rate. It is possible that 99-ending prices give the impression to the remaining consumers that products are more within reach, allowing them to enjoy more quality benefits than they otherwise would not have been able.

Similarly, contrary to our predictions, the 99-ending prices are more effective in promotional categories (i.e. with intensive feature advertising). It seems that consumers have more confidence in 99-ending prices in these categories. In promotional categories, they are accustomed to price discounts and 99-ending prices, thanks to their psychological effects, are associated with a price discount. This may also reflect the fact that retailers use 99-ending prices in weeks where they promote brands more than in weeks where there is little promotion.

Implications: Consistent with Thomas and Morwitz's (2005) results, we find that nine-ending prices may sometimes but not always be perceived to be lower than a price one cent higher. Conditions exist where these nine-ending prices are more or less effective in influencing customer behaviors. This pricing tactic has a psychological effect, which increases the likelihood of purchasing products priced in such a manner. However, the psychological effect seems to depend on the context. We also complement prior studies focusing on cross-category differences in price elasticities (Pauwels et al., 2007; Bolton, 1989), as we show that even nine-ending prices have effects on customer behaviors, which vary across categories. We contribute to the existing literature (e.g. Anderson and Simester, 2003; Martínez-Ruiz et al., 2006; Bray and Harris, 2006; Schindler and Kibarian, 1996), as we show that there are conditions, which favor the achievement of the benefits of 99-ending prices and conditions that hamper its benefits to materialize.

Our findings offer retailers a way to set prices ending in 99 across categories. Retailers should know that the use of a 99-ending will not always be a success but can fail. Specifically, in concentrated categories, there are large benefits to 99-ending pricing in terms of market penetration but maybe not in terms of

[3] We thank reviewer 2 for making this suggestion.

purchase quantity. When the purpose is to increase market penetration, retailers should avoid using 99-ending prices in expensive categories. Nevertheless, if the purpose of the retailer is to increase the purchase quantities among the existing buyers, our results show that using a 99-ended price could be an effective means.

Limitations and Future Research Issues: This study has some limitations, which provide promising areas for future research. First, our empirical evidence uses data from two retailers from one city. Therefore, we need additional research to establish generalizability. Furthermore, future research should consider whether incorporating competing brands' prices matters when assessing the effects of nine-ending prices. Third, we need to examine the effects of the asymmetric changes between rounded and nine-ending prices on consumer behaviors. For example, how do customers respond when the retailer changes the price from 10 to 9.99 versus 10.70 to 10.69? Our analysis looked at the effect of price format not the effect of the price variation. Yet, Thomas and Morwitz (2005) found that nine-ending prices are perceived to be smaller than a price one cent higher if the leftmost digit changes to a lower level (e.g., $3.00 to $2.99) but not if the leftmost digit remains unchanged (e.g.,$3.60 to $3.59).

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