Brand-Pack Size Cannibalization arising from Temporary Price Promotions – an examination in two FMCG markets

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Abstract

This study investigates the extent to which price promotions for one pack-size of a brand steal sales from the other pack-sizes of the same brand. The study applies a regression model with unit sales as the dependent variable, to two product categories. The analysis shows quite marked cross-pack cannibalization. On average, 21% of the sales uplift for the promoted pack-size comes from other pack sizes of the same brand. A lagged effect of price promotions is also evident for individually promoted pack sizes, including those of a private label brand, with approximately 20% of the instantaneous sales spike being borrowed from future weeks' sales.

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Introduction: Price Promotions and Cannibalization

Temporary price promotions are widespread in many markets, particularly so in consumer packaged goods markets. It is common for a very large proportion of total category volume in such markets to be sold 'on deal'.

Researchers have generally analyzed the effects of these price promotions using the *brand* as the level of analysis. In other words, unit sales and price data for SKU's (stock-keeping units) are often aggregated up to the brand level. However, it is quite common for specific brand SKU's, such as a brand-pack size, to be discounted, while the other brand SKU's are held at normal price. Is some of the sales increase to the promoted SKU cannibalized from the non-promoted SKU's of the same brand ? In simple terms, if a brand-pack size such as Kellogg's Corn Flakes 500 gram is promoted, how much volume does it steal from the 275 and 750 gram versions of the same brand ? It is intuitive that some cannibalization will occur in this scenario – but how much ?

Finding out more about the extent of such cannibalization has clear managerial implications for both manufacturers and retailers, because the profitability of a price promotion for any given brand depends partly on the extent of such cross-pack cannibalisation. Take the example of a brand comprising two SKU's each selling 100 units per week at normal price – one 'medium' size selling for $1.00 and one 'large' size selling for $1.50. Each has a 50% contribution margin, totalling .50 cents per unit for the medium and .75 cents for the large. Contribution is (100 x .50c + 100 x 0.75c) = $125 at normal price. Next, the large pack size is temporarily discounted by 20%. With a price-promotion elasticity at the average level of approximately -4 (Steenkamp, Nijs, Hanssens, & Dekimpe, 2005), unit sales for the promoted item could increase by 80 units to total 180 units per week for the period of the promotion. If there is no cannibalization across the pack sizes, total contribution increases to (100 x 0.50c + 180 x .45c) = $131. The promotion has earned an increase in contribution due to the high price elasticity. Next, consider if 20 percent of the uplift for the large pack is simply a transfer of sales from the medium pack – customers switching from the medium to the large. This will total 20% of the uplift of 80 units, namely 16 units. Contribution is now (86 x 0.50 + 180 x .45c) = $123. The promotion has gone from earning more contribution to making a small loss – total contribution for the week is less than what it would be selling normal quantity at normal price. This example is simplistic but illustrates the point – cross-pack cannibalization can harm promotion profitability.

The preceding example also indicates that if cross-pack (or other cross-variant such as form or formula) cannibalization occurs, calculating the effect of a price promotion solely by examining the promoted line-item will overstate profitability. Given the ubiquity of price promotions, and the profit implications, more investigation into the issue of cannibalization is warranted. The purpose of this paper, therefore, is to progress our knowledge about how price promotions for one brand-pack size steal sales from the other brand-pack sizes and if so, by how much. The paper proceeds as follows: a brief review of literature pertaining to price promotions, and cannibalization is conducted. Next, an analysis model is formulated, data for two product categories are described and the analysis is presented. The paper concludes with several managerial implications and directions for future work.

Literature Review: Price Promotions

Price promotions are endemic in consumer markets for several reasons. Principally, they 'work' – in the sense they reliably increase short-term unit sales. Since managers are generally under pressure to achieve short-term budget requirements, price promotions are an attractive option to drive unit sales – in the short-term. However, many studies have pointed to the adverse effects of repetitive price promotions over longer periods, such as training consumers to buy on deal (Mela, Gupta, & Lehmann, 1997; Mela, Jedidi, & Bowman, 1998) and competitive escalation (Dekimpe & Hanssens, 1999).

In recent years, several advances have been made in our knowledge about price promotions. The average price promotion elasticity from in-market studies is reportedly around -2.5 to -3 (Bijmolt, van Heerde, & Pieters, 2005; Danaher & Brodie, 2000); or -4.0 (Steenkamp et al., 2005). Some studies report much higher figures: for example Bemmaor and Mouchoux (1991) report a range between -2 to -11. We also know that in-store display support for a price promotion has a multiplicative effect of about 1.5 to 2 (van Heerde, Leeflang, & Wittink, 2001, figure 5 pp. 212). The 'post-promotion dip,' which for some years appeared difficult to empirically identify, has been documented in several studies over the past decade (e.g. Dawes, 2004; van Heerde, Leeflang, & Wittink, 2000). Indeed *pre*-promotion dips have also been reported (Mace & Neslin, 2004). More generally, price promotions have been found to generally induce only transient effects on sales (e.g. Pauwels, Hanssens, & Siddarth, 2002).

While brand managers often wish to stimulate brand sales in the short term via price promotions, they often do not price-promote the entire brand range. Rather, a specific pack-size of a brand or sub-brand is selected for promotion (for example, not 'Kraft' or even 'Kraft American Singles cheese slices' but 'Kraft American Singles 12 oz cheese slices'). This selectivity aids retailers' advertising and in-store support, as it facilitates the identification of a specific saving to consumers for that specific pack-size. The question then arises, as to how the promotion for a specific pack size affects the sales of other pack sizes of the same brand: what can be called pack-size cannibalization. A small number of studies have reported on cannibalization across brand variants such as pack sizes, as part of larger-scale investigations. Van Heerde (2004) reports a very high proportion of cross-brand effects comes from other SKU's of the same brand, in a study across two grocery categories. Similarly, Kalyanam and Putler (1997) graphically shows how a promotion for a large pack size of Heinz ketchup drastically reduces sales for other Heinz ketchup pack sizes. Based on these studies, it seems likely that pack-size cannibalization could be a serious problem for marketers, but more knowledge is needed. Specifically: how big is the cannibalization effect ? Is the cannibalization effect only instantaneous, or are there lead and lagged cannibalization effects (e.g. in the weeks before and after the price promotion) ? The answers have implications for manufacturers as well as retailers. Consider that a manufacturer will often reduce the price at which the retailer buys the brand for the period of a promotion. Hence, price promotions involve a sacrifice of margin for the manufacturer. If there is cannibalization across different pack sizes of the same brand, the manufacturer is inducing some consumers to simply buy a different pack size of the same brand, at a lower than normal price – for no net gain for the maker. Note that repeat-purchase loyalty is not enhanced by cannibalization because cannibalization arises from buyers who would have bought the brand *anyway* (at normal price). Turning now to the retailer's viewpoint, price promotions can be funded by lowering

margin on the promoted brand. If the promotion transfers sales from one pack-size to another, this means the retailer is also needlessly giving up margin.

Knowing more about cannibalization has at least three managerial benefits. Firstly, it may allow better appreciation of the likely profit outcomes of price promotions – for both manufacturers and retailers. Secondly, to identify price promotion tactics that minimise cross-pack cannibalization and hence preserve profit contribution for manufacturers and retailers. Third, to provide better forecasting of the sales of non-promoted SKU's which could aid production and inventory planning. The research questions are therefore:

1. Is there promotion-induced cannibalization across the pack-sizes constituting a brand, and if there is, what magnitude is it ?
2. Is this cannibalization only instantaneous, or are there possibly lag or lead effects – e.g. does the price promotion for brand-pack size *A* affect unit sales of pack size *B* for the same brand, in the weeks prior to, or after the promotion ?

Data

Two product categories are used in the analysis as the first stage in a broader study. Data for both categories were extracted from the Dominick's finer foods database (thanks to the Chicago Booth School of Business). The first category is toothpaste. The two largest brands, Crest and Colgate are used for the analysis. Each brand features three pack-sizes. The second category is sliced cheese, also from the Dominick's finer foods database. The two largest brands are used for the analysis, including the Dominicks private label. Data were pooled across stores. Note the Dominick's stores comprise different pricing regimes, therefore a subset of 38 stores were selected that have the same pricing code (denoted as 'medium' in the Dominick's database), these stores exhibit close similarity in weekly pricing. The first 104 weeks of the data were used for modelling. The Dominick's data was found to exhibit significant data anomalies such as a tenfold increase in sales of almost all brands in certain weeks (weeks 13 and 30) while prices remained comparatively normal. Massive outliers such as these were smoothed for the analysis.

Model formulation

The relationship of interest is between *short-term* changes in price / promotional variables, and unit sales volume at the SKU level. Longer-term effects of price changes (e.g. Pauwels et al., 2002) are outside the scope of this study. The analysis is based on the Scan*Pro model (van Heerde, Leeflang, & Wittink, 2002) - a regression model with the dependent variable being unit sales of a particular brand-pack size, for example, Colgate 4 oz. toothpaste. Exogenous variables are price indices of all the Colgate toothpaste pack sizes; lagged $t-_n$ and $t+_n$ as appropriate. Price index is calculated as ((actual price – normal shelf price) / normal shelf price). In addition, indices of specific competitors' prices are included, as well as a share-weighted price for the remainder of the category. Seasonal indicators are included as dummy variables to indicate a particular season, or event such as Christmas, which exhibit a different level of demand. The model is based on that used by van Heerde (2000) and Mace and Neslin (2004) to identify pre-and post-promotion dips. In those studies, an autoregressive term was included in the model, the present study also includes a moving average error term where such a component was identified in the data series. The analysis was conducted using the SPSS forecasting time-series module. Both unit sales and the price variables were log-

transformed, as the resultant regression parameters are interpretable as arc elasticities. Note, since the model is one of *unit sales*, instantaneous category expansion (Bell, Chiang, & Padmanabhan, 1999; van Heerde et al., 2004) is implicitly catered for.

The data were checked for stationarity prior to analysis. Non-stationary data require differencing before analysis, but the data used here was found to be stationary. The lag structure of the model was determined from preliminary analysis of ACF and PACF plots as well as the Akaike and Bayesian criteria. Model fit was ascertained using the Bayesian Information Criterion and the stationary R^2. A key requirement of time-series regression is that the residuals are white noise (e.g. Yaffee & McGee, 2000), this was checked via the Ljung-Box Q statistic. A non-significant Q supports the hypothesis of white noise. This approach was supplemented with inspection of ACF/PACF plots of residuals. In some cases an additional autoregressive term (e.g. unit sales lagged t-4) was added to achieve the desired randomness in model residuals. In most cases the autoregressive and moving average parameters were statistically significant, suggesting their incorporation into the model is appropriate. The model fits were excellent with stationary R^2's between 0.58 and 0.95 (Table 2).

Results

The results show that:
(1) There is quite marked cannibalization across brand-pack sizes from price promotions: on average, 21% of unit sales uplift for the promoted brand-pack size came from cannibalization of the other pack sizes of the same brand (Table 1).
(2) The cross-pack cannibalization effect appears to be confined to the week of a promotion. No statistically significant lead or lag cannibalisation effects were identified.
(3) Small pack sizes can steal sales from large pack sizes as well as vice versa.
(4) The cross-pack cannibalization effect can be seen for store brands as well. For example, the 12 oz pack size for the private label brand Dominick's American Singles steals sales from the 16 oz. version of the same brand (Table 1).

A lagged effect of promotion price is identifiable in several instances, for individual pack-sizes. That is, a lower than normal price in one week can dampen unit sales in subsequent weeks. Note, this may not necessarily mean a post-promotion *dip*, it may mean a dampened promotional *uplift* if last week's price was lower than normal. On average, 20% of the immediate sales spike comes from later week's unit sales (Table 1), which re-inforces previous findings (e.g. Mace & Neslin, 2004; van Heerde et al., 2000). The post-promotion effect is found for both sizes of the Dominick's store brand (e.g. temporarily lower price leads to lower sales in subsequent weeks). This finding underscores the relevance of price-promotion research to retailers, as well as brand manufacturers. Only one clear instance of a pre-promotion dip was identified, for Crest 4 oz toothpaste. However several other pre-promotion effects were in the opposite direction to expected (e.g. pre-promotion *rises*) – possibly due to promotions starting before the recorded date.

Table 1 Summary of Results (based on regression parameters of log-transformed data)

Category	Brand-pack size	How much of the uplift from a price promotion for this size, comes from the *other* pack sizes of the same brand ?	How much of the uplift comes from future weeks' sales of this SKU ?
Tooth-paste	Crest 4 oz	4	27
	Crest 6 oz	30	17
	Crest 8 oz	23	12
	Colgate 4 oz	0	31
	Colgate 6 oz	33	9
	Colgate 8 oz	25	0
Sliced-cheese	Kraft AS 6 oz	0	30
	Kraft AS 12 oz	34	20
	Dominick's AS 12 oz	19	41
	Dominick's AS 16 oz	43	21
	Average	**21**	**20**

** AS = American Singles. Kraft AS also in 36 oz but these exhibited low unit sales*

Table 2 Model fit

Category	Brand-pack size	Stat. R^2	BIC	Ljung-Box		
				Q	d.f.	p
Toothpaste	Crest 4 oz	0.72	13	15	16	0.49
	Crest 6 oz	0.87	12	17	16	0.41
	Crest 8 oz	0.70	11	13	16	0.70
	Colgate 4 oz	0.94	12	21	15	0.15
	Colgate 6 oz	0.84	12	20	15	0.17
	Colgate 8 oz	0.85	10	20	16	0.22
Sliced Cheese	Kraft AS 6 oz	0.58	12	13	16	0.67
	Kraft AS 12 oz	0.77	16	6	16	0.98
	Dominicks AS 12 oz	0.69	13	17	16	0.34
	Dominicks AS 16 oz	0.77	12	17	6.7	0.98

Conclusion

Many authors have pointed to the fact that price promotions are often not profitable. The results shown here help explain why: fewer true incremental sales accrue to the brand when one of its pack sizes is promoted, because an appreciable proportion come from other pack sizes of the same brand. The managerial implication is that price promotions must be assessed across the entire brand; it is not enough to inspect a sales spike for a promoted pack-size. The extent of cannibalisation from other brand-pack sizes must be factored into calculations of the profitability of a price promotion. Added to this sobering thought is that the sales spike for the brand-pack size may be borrowing some sales from next week, as identified in prior studies. These results highlight the ongoing importance of research into price promotion effectiveness – for both brand manufacturers and retailers.

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