THE EFFECTS OF REAL EARNINGS MANAGEMENT ON THE FIRM, ITS COMPETITORS AND SUBSEQUENT REPORTING PERIODS

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Abstract:

Prior research hypothesizes that managers use a variety of 'real actions' to manage reported earnings to meet or beat certain key benchmarks. Combining two years of new, supermarket scanner data for a commodity consumer product with firm-level financial data, I find evidence consistent with the hypothesis of price discounting around the fiscal quarter-end. Firms that just beat prior year quarterly Earnings per Share or Analyst Consensus Earnings Forecasts reduce prices in the final month of the fiscal quarter to do so.

Also examined are the effect of earnings management related price reductions on subsequent reporting periods and on competitor pricing behavior. I find that price reductions associated with a single earnings management target are persistent over multiple reporting periods and that competitors also reduce prices when a firm has greater incentives to discount prices to manage earnings. These findings suggest the effects of Real Earnings Management on subsequent reporting periods and competitor behavior are greater than previously thought.

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1. Introduction

This paper examines the use of price discounts at the fiscal quarter-end to manage reported earnings, as well as the effects of such price discounts on competitors' pricing behavior and subsequent reporting periods.

Prior research[1] indicates that in addition to using financial reporting judgment, managers use a variety of 'real' actions to manage reported earnings to meet or beat certain key benchmarks. For durable goods, price reductions prior to the fiscal quarter-end are legal and can be used to boost sales volumes and earnings temporarily. This makes them ideal as earnings management tools.

To test whether price reductions are used in this manner, I examine firms that just beat their prior year quarterly Earnings per Share ("EPS Target") or Analyst Consensus Earnings Forecasts ("ACEF Target"). These firms are expected to have stronger incentives to boost earnings in order to reach these targets.

If customers stockpile product which is discounted at the end of a quarter,[2] purchase demand is likely to decline in the following quarter. I investigate this relation and whether it leads to an increased likelihood of price discounts in subsequent periods as the firm seeks to support dwindling sales.

[1] See Schipper (1989), Healy and Wahlen (1999), Graham, Harvey and Rajgopal (2005), Gunny (2005), Roychowdhury (2006) or Chapman and Steenburgh (2007) for examples.
[2] Gupta (1988) proposes that sales increases associated with price promotions are caused, in part, by customer stockpiling.

Finally, given the association of brand switching with price reductions[3] and the substitute nature of the product studied, price reductions in one firm are also likely to affect the pricing behavior of competitors seeking to protect their own market position. I therefore examine the interaction between a firm's earnings management incentives and the pricing behavior of its competitors.

This paper uses a new dataset containing two years of supermarket scanner data for a commodity consumer product (soup). The granularity of the scanner data allows direct observation of the price discounting behavior which previously has only been studied indirectly.[4] Soup was selected as the product category for four distinct characteristics: its non-perishable (durable) nature; its frequency of purchase; its price elasticity of demand; and ease of stockpiling by the end consumer. These characteristics suggest it might be a good candidate for use in earnings management activities.

The findings show that firms who just beat either their EPS or ACEF Targets reduce prices by an average of 10-15% in the final month of the fiscal quarter, even after controlling for abnormal inventory levels. Further, the earnings management related discounting is persistent; firms that reduce prices to meet EPS Targets at the end of one fiscal quarter reduce their prices again twelve months later by an estimated 7%. Such subsequent price reductions are above and beyond the levels predicted based upon contemporaneous earnings management incentives. Consistent with the prediction about competitor response, earnings management incentives at one firm are related to

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[3] See Gupta (1988).

[4] In contrast to the direct evidence presented here, prior research by Gunny (2005) and Roychowdhury (2006) uses a model from Dechow, Kothari and Watts (1998) to estimate the normal level of Cash Flow from Operations. They then propose that abnormally high production costs are indicative of overproduction to decrease Cost of Goods Sold or sales manipulation.

competitor price discounting. Assuming the market share of firms that are expected to be managing their earnings upwards is 20%, these discounts are estimated to be 25% and 5% if the firm just beats its EPS Target and ACEF Target, respectively.

These results are consistent with firms discounting prices to achieve earnings benchmarks and show these actions span multiple reporting periods and also affect competitor pricing behavior.

The remainder of the paper is organized as follows. Section 2 provides background, describes prior research and develops testable hypotheses about the timing and effects of price discounting behavior. Section 3 describes the sample selection procedure and research methodology. Section 4 presents empirical results and Section 5 contains concluding remarks.

2. Hypothesis Development

2.1. Short-Term Earnings Increase from Price Discounts

The interplay between the use of accounting discretion and real actions to manage earnings has been of interest to academics for several years. In their paper considering the immoral and unethical nature of earnings management practices, Bruns and Merchant (1990) find that managers consider the management of short-term earnings by *accounting* methods to be significantly less acceptable than accomplishing the same ends by changing or manipulating *operating decisions or procedures.*

Graham, Harvey and Rajgopal (2005) surveyed managers and concluded that they are more likely to make real economic decisions to manage earnings than to take accounting actions. Seventy-eight percent of managers surveyed admit to taking actions which sacrifice long-term value to smooth earnings and choose real actions over accounting actions to meet earnings benchmarks.

Gunny (2005) summarizes four activities which, according to prior research, firms use to manage earnings: cutting Research and Development ("R&D") to increase income[5]; changing Sales, General and Administration ("SG&A") expenditure to increase income[6]; timing income (and loss) recognition from the disposal of long-lived assets and investments[7]; and discounting prices to boost sales in the current period and/or overproducing to decrease Cost of Goods Sold ("COGS").[8] Her evidence suggests that all four types of real earnings management negatively impact subsequent operating performance.

Prior studies on real earnings management, including Gunny (2005), Roychowdhury (2006) and Cohen, Dey and Lys (2007), estimate abnormal cash flow from operations and abnormal production costs to infer earnings management. However, they cannot explicitly test whether their results are caused by price discounting or overproduction.

The data in this study uses observations of actual price changes at the product level. This makes it possible to extend the work of Chapman and Steenburgh (2007) and test whether price discounts are related to multiple earnings management incentives of the firm and its

[5] See Baber et al (1991), Dechow and Sloan (1991), Bushee (1998), Bens, Nagar and Wong (2002) and Cheng (2004) for further discussions of the role of changing R&D expenditure in various earnings management contexts.
[6] See Chapman and Steenburgh (2007) and Mizik and Jacobsen (2007) for further discussion of the role of marketing expenditure in this context.
[7] See Bartov (1993) and Thomas, Hermann and Inoue (2003) for further discussions on the use of asset sales or McNichols and Wilson (1988) on the use of opportunistic provisioning in this context.
[8] See Thomas and Zhang (2002) on the use of overproduction and Roychowdhury (2006) or Chapman and Steenburgh (2007) for further discussion on the role of price discounting.

competitors. I am unaware of any other papers which use recent data at this level of granularity to provide evidence of price discounting around the end of the fiscal period.

Within the field of marketing there has been considerable research on customer response to price discounting. Gupta (1988) decomposes the sales 'bump' during the promotional period into three components: increased overall consumption (market growth), purchase time acceleration (stockpiling) and brand switching. Macé and Neslin (2004) present evidence that temporary price reductions can be used to increase revenues during the promotion period. However, they also show a dip in sales volume both before and after the promotion as consumers are able to time purchases.

Temporary price reductions increase earnings up to the end of the price promotion period if the contribution from increased sales during the promotion is sufficient to offset foregone contribution from sales lost in anticipation of the promotion as well as the opportunity cost of reduced revenues from the sale of product at the new, lower price during the promotion. Ceteris paribus, firms with lower marginal costs (higher margins) benefit more than those with high marginal costs from this type of behavior. Further, if there is a large post-promotion dip in sales due to consumer stockpiling, a temporary price reduction can actually decrease earnings over the entire period.[9]

When considering which product category to study, I draw on prior research by Narasimham, Neslin and Sen (1996) and Pauwels, Hanssens and Siddarth (2002) who find that soup, a non-perishable (durable) product, is easily stockpiled and purchased in

[9] The existence of a post-promotion sales dip is one possible explanation for the financial underperformance observed for firms following periods of earnings management, documented in papers by Teoh, Welch and Wong (1998) and Gunny (2005).

greater quantities when offered at a discount. Together with its frequency of purchase, these characteristics make it a good candidate to study in relation to potential earnings management activities.

Hypothesis *H1* proposes that the relationship between customer stockpiling, limited brand switching and the price elasticity of demand for soup is such that a temporary price reduction leads to an increase in earnings prior to the end of the price promotion, but reduces total earnings over the entire period (before, during and after the promotion).

Hypothesis H1 *Increases in sales volumes, associated with a short-term price reduction, are sufficient to boost short-term earnings up to the end of the promotion but reduce long-term earnings.*

As discussed by Arya, Glover and Sunder (1998), earnings management behavior of the type studied here, which appears costly to the firm, may exist in equilibrium for a number of reasons. First, it may not be cost-effective for participants to prevent real earnings management. Second, it may not be cost effective for some market participants to fully understand this behavior, enabling firms to access debt or equity capital at lower prices. Even if these conditions do not hold, managers may engage in real earnings management if they believe there is a possibility that some benefit will be gained.

2.2. Price Discounting and Period-End Incentives

A firm (or manager) facing incentives to accelerate earnings can reduce prices in one period to boost short-term earnings at the expense of long-term earnings. (See Case 1 in Appendix A). This behavior can give rise to earnings patterns observed by Burgstahler and Dichev (1997).[10] It is also consistent with Fudenberg and Tirole (1995) and Oyer (1998) who hypothesize firms reduce prices towards the end of the period due to dividend smoothing and manager incentive effects.[11]

Degeorge, Patel and Zeckhauser (1999) and Graham, Harvey and Rajgopal (2005) each propose three earnings benchmarks which managers cite as being important. These relate to meeting or beating:

i) EPS from the same quarter in the previous year ("EPS Target")

ii) Analyst Consensus Earnings Forecasts ("ACEF Target") and

iii) Zero quarterly profit.

These papers all suggest that the marginal benefit of earnings management increases sharply as earnings are managed upwards across these benchmarks giving rise to the following Hypothesis *H2*.[12]

Hypothesis H2 Firms reduce prices at their fiscal quarter-end when they also just meet or beat their EPS or ACEF Target.

Degeorge, Patel and Zeckhauser (1999) propose studying firms with EPS in the range 0-1¢ when considering earnings management incentives around the zero profit. However, the sample period used here encompasses generally positive results for most of the firms

[10] Durtschi and Easton (2005) suggest that the shapes of the frequency distributions of earnings metrics at zero cannot be used as ipso facto evidence of earnings management and are likely due to the combined effects of deflation, sample selection, and differences in the characteristics of observations to the left of zero from those to the right

[11] In contrast, Healy (1985) and Goel and Thakor (2003) identify several situations where managers have incentive to reduce earnings and would therefore be motivated to increase prices.

[12] See Burgstahler and Dichev (1997) for a further discussion of the motivation to manage earnings past miscellaneous benchmarks.

studied with no observations in this range and few in the 0-10¢ range. I therefore leave for future consideration the role of 'beating zero' as an earnings management incentive of this type.

2.3. Competitive Response

Prior research has considered the intra-industry contagion effects of various actions and announcements on firm valuations.[13] These generally consider changes in market valuation of competitor firms around disclosures affecting a single firm. The effect on competitors' valuations is consistent with investors ascribing a higher likelihood that the competitor firms will experience similar economic outcomes to the announcing firm.

For example, when considering a sample of firms prosecuted by the Securities and Exchange Commission for fraudulent reporting ("Scandal Firms"), Karaoglu, Sandino and Beatty (2006) present evidence suggesting that competing firms manage earnings more (as measured through discretionary accruals) when their performance lags behind a Scandal Firm.

Extending this concept to real earnings management, this paper allows consideration of an alternative mechanism, that managers increase their own real earnings management behavior in response to the real earnings management of competitors.

[13] Docking, Hirschey and Jones (1997) find that the announcement of loan loss provisioning by one firm can lead to stock-price changes in non-announcing firms. Similarly, Gleason, Jenkins and Johnson (2008) show accounting restatements that adversely affect shareholder wealth at the restating firm also induce share price declines among non-restating firms in the same industry with the effects concentrated among revenue restatements.

The competitive response to price discounting has been widely studied in literature on strategic competition, price collusion and oligopoly.[14] Although prior work considers the linkage between exogenous demand shocks and competitive pricing, I am unaware of any research which link price reductions associated with earnings management incentives to a competitive response.

Case 2 in Appendix A presents an analytical model which illustrates the potential for this behavior. The model shows that even competitors with no explicit incentive to accelerate earnings are likely to reduce prices in response to a firm which has incentive to accelerate earnings. This leads to the following hypothesis:

Hypothesis H3: Competitor firms reduce prices when other firms within their industry are expected to discount prices to meet earnings targets.

Competitive responses to earnings management price discounts will only be observed if firms can either anticipate or respond quickly to competitor price changes. Both are plausible given knowledge about firms' fiscal year-ends and the timing of other types of promotions (aisle displays and feature advertisements) which are often scheduled months in advance. Indeed, the concept that firms monitor and act on information about their rivals is the basis for considerable literature on limits to discretionary disclosure. (Verrecchia 1983, 1990). Similarly, many large companies dedicate resources to organized competitive intelligence activities, defined as the collection and analysis of (generally public) data about one's competitors as part of formulating one's own strategic

[14] Examples include Green and Porter (1984), Bresnahan (1987), Borenstein and Shepard (1996) and Nevo (2001) and Che, Seetharaman and Sudhir (2007). Fudenberg and Tirole (2000) also consider the problem from the standpoint of poaching customers.

plans and decisions (Lavelle 2001). Finally, the lead time between the decision to act and a retail price change is normally several weeks but can be accelerated to a matter of days, if needed, depending on the nature of the supermarket pricing system.

2.4. Persistence of Price Discounting Behavior

The monopoly model presented as Case 1 in Appendix A suggests that players should reduce prices at fiscal period end when they have an incentive to meet earnings targets. However, what happens at the end of the following year? Assume that in Period 1, the firm has an earnings target of $10 but normal operations would result in earnings of $9. By offering a small price discount, the firm can meet the earnings target of $10. Even if we assume this 'borrowing' to be costless overall, it has the effect of reducing subsequent period earnings by $1. At the end of the second period, if operations continue at the same level, the firm will generate earnings of $8. (The $9 from normal operations less the $1 which was borrowed in period 1). To meet a $10 target, the firm must now borrow $2 from the future.

The intuition behind this simplified example is developed more fully based solely on the competitors' beliefs about future behavior and is presented in Case 3 of Appendix A. The model reveals that a firm in a duopoly setting with no explicit incentive to reduce prices should do so, simply because its competitors act as if they believe there is a non-zero probability that it will.

This model leads to Hypothesis *H4* which suggests price discounting behavior can become persistent, leading to price reductions repeating twelve months following the initial incentive to boost earnings:

Hypothesis H4 *Prices will be lower than 'normal' at the fiscal quarter-end twelve months after a firm just beat its EPS/ACEF Target.*

2.5. Inventory Management as an Alternative Explanation

Although temporary price reductions can be used to increase earnings prior to the end of the price promotion, firms with unusually high inventory levels may also use pricing decisions to bring inventory back to a normal range. Tests of the main hypotheses will therefore need to control for this competing explanation.[15]

3. Data and Methodology

For this study, a significant new dataset collected between January 2005 and December 2006 was obtained from a leading US supermarket chain. The dataset contains information on all purchases made by 2,000 households randomly selected from the supermarket chain's clientele representing over 3.5 million purchase observations. The households are all spread across the Northeast of the United States where the chain is one of the largest food retailers.

Prior research by Narasimham, Neslin and Sen (1996) and Pauwels, Hanssens and Siddarth (2002) find that soup, a durable product, is easily stockpiled and purchased in greater quantities when offered at a discount. Together with the frequency of purchase,

[15] I thank Ross Watts and seminar participants at Harvard Business School for pointing out this possibility.

this suggests that soup will be a good candidate for use in earnings management activities. The analysis is therefore restricted to the 1,545 different UPC codes (product barcodes) within the soup category representing 41 different manufacturers.

For each individual UPC code, the dataset is expanded by identifying the product producer and ultimate parent company. For each of the parent companies, the information regarding the fiscal year-end, financial performance and analyst forecasts for each of the parent companies was retrieved from multiple sources including Thompson Financial, I/B/E/S, Corporate Websites, Compustat and One Source. Fiscal year-end data was obtained on 26 of the 41 manufacturers representing approximately 94% of the total purchase transactions within the soup category.

Summary statistics of my dataset which contains a total of over 3.6 million individual item purchases over the two years of observation, 55,451 of which are sales of soup products are shown in Table 1. Within this sub-sample, it is possible to identify the manufacturer for 53,637 (97.0%), fiscal calendar for 52,138 (94.0%), EPS data for 42,434 (76.5%) and ACEF for 41,726 (75.2%) observations.

To eliminate any bias which might be caused by the inclusion of multiple purchases of the same product at similar prices in the same week, the mean price observed for each UPC-week pair is used.[16]

The data selection criteria bias the sample slightly towards larger and less expensive brands. The mean of weekly sales, measured by *Ln(Weekly Units Sold)*, is 1.19 at a mean price of $1.59 for the sample used compared to 0.81 at $1.81 for the full sample.

[16] Sales volumes are consolidated to a single observation per UPC-week when used.

4. Results and Discussion

4.1. Price Elasticity of Demand

To measure the effect of price discounting on sales volumes and profitability to test Hypothesis *H1*, four variants of the following regression are estimated.

$$Ln\left(WeeklyUnitsSold_{it}\right) = \alpha + \sum_{j=-2}^{2} \beta_j Ln\left(\frac{Price_{i,t+j}}{MaxPrice_i - Price_{i,t+j}}\right) + \sum_{j=1}^{12} \gamma_j Month_j + \varepsilon_{it}$$

where $WeeklyUnitsSold_{it}$ is the number of units of soup product *i* sold in week *t*.[17] $Price_{i,t}$ is the mean price at which product *i* is offered in week *t*. $MaxPrice_i$ is the maximum average weekly price at which product *i* is offered during the sample period.[18] Scaling of the *Price* variables is designed to take account of different prices for products of different sizes and brands and allow for cross-sectional analysis. However, *Price/MaxPrice* is a variable bounded between zero and one. A logistic transformation *Ln(p/(1-p))* is therefore used where *p* = *Price/MaxPrice*.[19] This conversion expands the values to the real numbers.[20] *Month* represents dummy variables for each calendar month.

[17] Scaling this variable by the Minimum Number of Units Sold in a week for product *i* does not materially change the results.
[18] Use of a backward looking definition of *Maxprice* which defines the variable as the highest price at which the product has been offered up to time *t* does not materially change the results.
[19] See Demsetz and Lehn (1985) for the use of similar transformations.
[20] Although the transformation of the independent variable is not essential here, I present results in this manner for consistency since I use the transformed price variable as the dependent variable in subsequent tests. In the sample there were no cases where the price was zero and few where the *Price* = *MaxPrice*. Use of an untransformed variable which includes observations where *Price* = *MaxPrice* provides results consistent with those presented here. Similar results are also obtained if I exclude 55 observations representing high value outlying values of this variable which occur when *Price* is close to *MaxPrice.*

There is significant calendar seasonality of demand as shown in Figure 1. To control for this variation in tests of Hypothesis *H1*, an approach consistent with prior literature[21] is used which includes calendar month fixed effects.

The error term ε_{it} contains information on competitor prices which may affect demand and also be correlated to the *Price* variable. Although this is partially mitigated by the use of the calendar month fixed effects, this may lead to correlated omitted variable bias. Model extensions including additional variables to control for average market price (results not reported) are consistent with limited brand switching behavior but do not materially affect the primary results of interest.

The four different estimations consider prices either one or two weeks before and after the week of interest[22] with or without monthly fixed effects to control for demand seasonality. The time period under consideration is extended to include two weeks before and after based on results from Macé and Neslin (2004)[23] which suggest that the effects of a price change on sales volumes may be observed more than one week before and after it occurs.

Assuming a conventional downward sloping demand curve for soup, the effect of current price on current volume (β_0) is predicted to be negative with price increases reducing sales volumes. However, given consumers' ability to stockpile soup,[24] positive values are anticipated for the coefficients measuring the effects of recent prices on current

[21] See Oyer (1998) or Chapman and Steenburgh (2007)
[22] Extension to weeks *t-3* and *t+3* was also studied and provides no additional significant coefficients.
[23] See Figure 2 of their paper.
[24] Narasimham, Neslin and Sen (1996) and Pauwels, Hanssens and Siddarth (2002) find that soup is easily stockpiled and purchased in greater quantities when offered at a discount.

period demand (β_{-1} and $\sum_{j=-2}^{-1} \beta_j$). Similarly, if consumers are able to anticipate future price changes and adjust current period purchases accordingly,[25] coefficients measuring the effects of future prices on current period demand (β_1 and $\sum_{j=1}^{2} \beta_j$) should also be positive.

The results of these four model estimations are shown in Columns 1 through 4 of Table 2. As expected, β_0 is negative and strongly significant suggesting that a 10% reduction in price is associated with an increase in sales volume of approximately 14%.

The coefficients on lagged prices (β_{-1} and $\sum_{j=-2}^{-1} \beta_j$) are positive, implying that a 10% price reduction in a given week is accompanied by a 2% reduction in sales over the following one or two weeks consistent with consumers stockpiling soup.

In contrast to the theoretical prediction, the coefficient relating to future prices (β_1) is negative.[26] When the model considers prices two weeks before and after the purchase (Columns 3 and 4 of Table 2), the overall effect of future prices on current demand ($\sum_{j=1}^{2} \beta_j$) becomes insignificant. The counterintuitive negative sign may be due to two factors: the use of non-price promotional activities around the price change (which are

[25] A process referred to a purchase deceleration in some marketing literature.
[26] Only significant at the 10% level when prices from two weeks before and after are included.

unobserved here);[27] or changes in customer behavior depending on the duration of a price promotion.[28]

Consider for example a price promotion lasting two weeks which becomes less effective in the second week. In this case, we would expect to observe higher values on the coefficient of future price (β_1 and $\sum_{j=1}^{2}\beta_j$) and lower coefficients on prior prices (β_{-1} and $\sum_{j=-2}^{-1}\beta_j$) consistent with the results observed here.[29]

To address this potential concern and improve model fit if customer demand levels change based upon the duration of a promotion, the model is refined by adding an additional independent variable $Ln\left(\frac{Price_{i,t}}{MaxPrice_i - Price_{i,t}}\right)*I$ where I is a dummy variable equal to one if $Price_{i,t-1} < Price_{i,t}$ and zero otherwise.[30] The results are shown in Column 5 of Table 2 and also graphically in Figures 3 and 4 for a price reduction lasting one and two weeks, respectively. These show a decline in demand during the second week of a two-week promotion, consistent with the idea that the promotion becomes less effective over time. The results on other coefficients of interest are not materially different except

[27] Results of further tests (not reported) show the effects of price discounts at the fiscal year-end are greater (the post-promotion dip is deeper) than for discounts of equal size at other times of the fiscal-year. This is consistent with the possibility of increased non-price promotional activities ahead of the fiscal year-end and the earnings management hypothesis studied in Chapman and Steenburgh (2007).

[28] Such complications in the estimation process are discussed at length in Van Heerde, Leeflang and Wittink (2000) and can be readily observed for comparable product categories in Figure 2 of Macé and Neslin (2004).

[29] A similar concern exists and remains unresolved in the results presented by Macé and Neslin (2004).

[30] Use of alternative indicator variables relating to the period which precedes a price decline provide similar results.

we now observe a clear reduction in demand both before and after the price promotion. This suggests that any concerns on mis-specification should be minimal.

4.2. The Direct Costs and Benefits of Real Earnings Management

The impact of a temporary price cut on profits depends on a number of factors including the product's price elasticity of demand and the firm's cost structure. To assess these, consider the following example.

Considering a three week period of constant prices p, contribution is given by $3(p-c).v$ where c is the marginal cost and v is the sales volume assuming all prices equal p. If prices are reduced to $\underline{p}$ in the middle week, the total contribution over the three weeks is given by $(p-c).v\big|_{p_{t+1}=\underline{p}}+(\underline{p}-c).v\big|_{p_t=\underline{p}}+(p-c).v\big|_{p_{t-1}=\underline{p}}$.

If price reductions are sufficient to boost short-term earnings up to the end of a promotion then there will be a net increase in contribution before and during the price cut evidenced by $(p-c).v\big|_{p_{t+1}=\underline{p}}+(\underline{p}-c).v\big|_{p_t=\underline{p}}>2(p-c).v$. If earnings are reduced overall, then any increased contribution before and during a price cut will be offset by the lost sales resulting from the lag effects after the promotion relating to earlier prices. Therefore:

$$(p-c).v\big|_{p_{t+1}=\underline{p}}+(\underline{p}-c).v\big|_{p_t=\underline{p}}+(p-c).v\big|_{p_{t-1}=\underline{p}}<3(p-c).v\cdot$$

Using the regression model presented in the previous section, the results (presented in Appendix B) show that a 15% price reduction lasting one (two) week(s) increases short-term earnings up to the end of a promotion if marginal costs (c) are less than 34.7% (34.7%) of regular retail price. Similarly, quarterly 'contribution' can be increased by up to 0.5%, Gross Profit increased by 0.6% and EPS increased by 2.5% if marginal costs are 18.2% (18.7%), gross margin is 68.1% (67.7%) and net margin is 16.4% (16.3%) of normal sale price.[31] Greater effects on EPS may be achieved by discounting prices further depending on the operating and financial leverage of the firm.

However, the presence of the post-promotion dip associated with the lag effects after of earlier prices $\left(\sum_{j=-2}^{-1} \beta_j \right)$ means that the one (two)-week 15%-off promotion will be costly overall unless the marginal cost of production is below 10.3% (9.7%).[32]

If the marginal cost of the product is less than 10% of the regular price then it would appear profitable overall to reduce prices temporarily. However, if a firm faces such a situation, it raises the question as to why they were not previously discounting prices.

Overall, this means that if marginal costs are within the range 10-35% of sales price, the price reductions will increase reported earnings before the end of the price promotion but will reduce total earnings over the entire period. In some cases, this cost is material. For example, a firm with cost structure similar to ones mentioned above which boosts quarterly EPS by 2.5% using a 15% one (two)-week price reduction would reduce quarterly EPS in the following quarter by approximately 3.3% (4.6%) based on the depth of the post-promotion dip in sales associated with the price discount.[33] This raises the possibility that firms may be tempted to repeat the price discount at the end of the following quarter to recover the subsequent cost which is discussed further below.

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[31] Calculations of these values are shown in Appendix B. The effect on EPS is highly sensitive to the net margin assumption.
[32] See Appendix B.
[33] Again, more severe effects are expected following larger price reductions.

An analysis of the financial statements of sample firms shows that the contribution margin is likely within this range. Indeed, the mean Cost of Sales:Sales ratio of sample firms is approximately 60% with raw materials estimated by one of the firms in the sample to be approximately 30% of Sales. With the supermarket chain under consideration reporting gross margins of approximately 25%,[34] this implies that the average firm in the sample has marginal costs of approximately 23% of the retail price.[35]

Comparing this figure to the 10-35% range highlighted above demonstrates that the many of the sample firms will be able to use price reductions to boost current quarter EPS but that this will reduce earnings in the following quarter by a greater amount consistent with Hypothesis *H1*.

A caveat to this conclusion is that only retail prices are observed, not the manufacturer sale price. Therefore, this interpretation of results requires the supermarket chain to pass through most of the discounts/promotions from the manufacturers as opposed to selectively targeting manufacturers' fiscal calendar or performance with their own pricing activities.[36] Discussion with representatives of one of the larger manufacturing companies confirmed that trade funding (money given to supermarkets to temporarily reduce prices, display product in prime merchandising space, or feature product in circulars) is usually structured so that the bulk of the units shipped to the supermarket at a discount must also be sold to the consumers at a discount. However, a small percentage "slip" through the system and are sold to consumers at or near full-price. If the

[34] Figure obtained from 10-K Filing of the Supermarket Chain

[35] Marginal Cost = 30% * Manufacturer Sales. Manufacturer Sales = 75% * Retail Sales. Marginal Cost = 23% of Retail Sales.

[36] This is consistent with the approach used by Kadiyali et al. (1996, 1999) who assume the retailer is nonstrategic and charges an exogenous constant margin.

supermarket does not pass on the price discounts from the manufacturers, this would bias my tests against finding results.

Overall, this evidence allows the conclusion that short-term price reductions result in increased sales volumes over the sample period. These sales increases were sufficient to boost short-term earnings up to the end of the promotion but reduce long-term earnings as a result of the drop in sales following the promotion.

This result means that firms within the sample can use short-term price reductions to manage reported earnings but long-term earnings are negatively affected by such behavior.

4.3. Meeting and Beating Earnings Benchmarks

Hypothesis *H2* proposes that firms will reduce prices at their fiscal quarter-ends to meet or beat each of the earnings benchmarks proposed in Section 2.2. This is tested by studying the pricing behavior of firms just beating different earnings benchmarks and comparing them to those with earnings not in these ranges by estimating several variations to the following regression: [37]

$$Ln\left(\frac{Price_{it}}{MaxPrice_i - Price_{it}}\right) = \alpha + \beta_1 JustBeatQEnd_{it} + \beta_2 JustMissQEnd_{it} + \beta_4 Ln\left(\frac{Price_{it-52}}{MaxPrice_i - Price_{it-52}}\right) + \beta_5 JustBeatQEnd_{it-52} + \beta_6 JustMissQEnd_{it-52} + \varepsilon_{it}$$

where $Price_{it}$ is the mean price at which product *i* is offered in week *t*. $MaxPrice_i$ is the

[37] An alternative specification might consider year-on-year price change. This is a more restrictive specification but yields similar results.

maximum average weekly price at which product *i* is offered during the sample period.[38] The scaling by *MaxPrice* is designed to take account of different regular prices for products of different sizes and brands and allow for cross-sectional analysis. However, *Price/MaxPrice* is a variable bounded between zero and one. A logistic transformation *Ln(p/(1-p))* is therefore used where *p = Price/MaxPrice*. This conversion expands the values of the dependent variable to the real numbers.[39]

$JustBeatQEnd_{it}$ is a dummy variable which equals one if the firm's earnings are 0-5% above the relevant target (the EPS or ACEF Target[40]) and the sale occurs in the last month of the manufacturer's fiscal quarter, and zero otherwise. $JustBeatQEnd_{it}$ is designed to identify firms and periods where there is a higher likelihood of quarter-end real earnings management.[41] The coefficient β_1 is therefore expected to be negative.

$JustMissQEnd_{it}$ is a dummy variable which equals one if the firm is 0-10%[42] below the relevant earnings target (the EPS or ACEF Target) and the sale occurs in the last month of the manufacturer's fiscal quarter, and zero otherwise. $JustBeatQEnd_{it}$ is included for comparison purposes. I therefore make no prediction on the sign of β_2.

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[38] Use of a backward looking definition of *Maxprice* which defines the variable as the highest price at which the product has been offered up to time *t* does not materially change the results.

[39] In the sample there were no cases where the price was zero and few where the *Price = MaxPrice*. Use of an untransformed variable which include observations where *Price = MaxPrice* provides results consistent with those presented here. Similar results are also obtained if I exclude 55 observations representing high value outlying values of this variable which occur when *Price* is close to *MaxPrice.*

[40] I use a single random forecast per analyst during the period 30-60 days prior to the earnings announcement to generate the ACEF Target variable. Alternative forecast horizons provide similar but slightly weaker results suggesting that managers are using price reductions to meet or beat forecasts from this horizon period more than those of other horizon periods.

[41] See Burgstahler and Dichev (1997) for a further discussion of the motivation to manage earnings past miscellaneous benchmarks.

[42] The 10% band is used here in preference to a 5% band due to the relative lack of observations in the 0-5% range below the prior year. Use of a 10% band for *JustBeatQEnd* does not materially change the results.

Use of monthly fixed effects could obscure the hypothesized inter-temporal persistence and competitor pricing effects. The models are therefore estimated including three additional control variables using price and incentive data from the same week of the previous year (*$Ln(Price_{it-52}/(MaxPrice_i - Price_{it-52})$, $JustBeatQEnd_{it-52}$* and *$JustMissQEnd_{it-52}$*) to control for seasonality.

The frequency of observations where firms are predicted to discount prices to meet earnings targets varies considerably by month and year. On average, approximately 11% (17%) of observations occur in quarters where firms just beat their EPS (ACEF) Target as shown in Table 1. Similarly, the 10% (9%) of observations occur in quarters where firms just miss the EPS (ACEF) Target. The band has been widened from 5% to 10% for firms missing the benchmarks to ensure adequate numbers of observations to estimate all models.

The results of the Earnings Management tests using the same quarter's EPS from the prior year as the EPS Target are presented in Column 1 of Table 3a.[43] The findings indicate that firms that just meet or beat last year's quarterly EPS have average price declines of 10% (β_1 = -0.429) in the last month of the fiscal quarter. In contrast, firms that just miss last year's quarterly EPS do not show any changes in pricing behavior at the fiscal quarter-end (β_2 not significantly different from zero).

When adding additional control variables, it appears that firms just missing their EPS Target also reduce prices (perhaps attempting to beat the target but failing to do so) but

[43] It is theoretically possible that the choice of fiscal year-end makes several of the variables in the model endogenous leading to biased coefficients. Re-estimation of this, and subsequent models using overall monthly sales volumes as an instrument for the probability of a fiscal quarter-end does not materially change the results.

by less than those firms which just beat their targets. This is evidenced by β_1 being significantly different from β_2 in Columns 1-4 of Table 3a.

The results of the Earnings Management tests using Analyst Consensus Forecast of Earnings as the ACEF Target are presented in Column 1 of Table 3b. The findings indicate that firms that just meet or beat the ACEF Target have average price declines of 15% (β_1 = -0.298) in the last month of the fiscal quarter. In contrast, firms that just miss the ACEF Target increase prices by approximately 15% ((β_2=0.655)[44] at the fiscal quarter-end. The justification for such price increases is unclear but, given that this pricing behavior boosts earnings the following period, is consistent with an earnings smoothing hypothesis.

These findings are consistent with the Monopoly Case model proposed in Case 1 of Appendix A and also the survey evidence of Graham, Harvey and Rajgopal (2005) that managers take real actions to meet prior year EPS as well as analyst expectations.

4.4. Competitive Response

Hypothesis *H3* proposes that competitor firms reduce prices when other firms within their industry are predicted to discount prices to manage earnings. To test this hypothesis, variations on the following regressions with respect to EPS and ACEF Targets are estimated:

[44] These results are robust to the inclusion of additional control variables used in subsequent tests.

$$Ln\left(\frac{Price_{it}}{MaxPrice_i - Price_{it}}\right) = \alpha + \beta_1 JustBeatQEnd_{it} + \beta_2 JustMissQEnd_{it} + \beta_3 IncentivesofOthers_{it}$$
$$+\beta_4 Ln\left(\frac{Price_{it-52}}{MaxPrice_i - Price_{it-52}}\right) + \beta_5 JustBeatQEnd_{it-52} + \beta_6 JustMissQEnd_{it-52} + \beta_7 IncentivesofOthers_{it-52} + \varepsilon_{it}$$

where $IncentivesofOthers_{it}$ equals the dollar market share of firms (excluding firm *i*) that have an incentive to manage earnings upwards in the current month as measured by having *JustBeatQEnd* equal to one. The variable would equal one if all firms in the industry (excluding firm *i*) are classified as having incentive to manage earnings to just beat the EPS (ACEF) Target and 0.5 if firms representing half of the industry (measured according to their market share) have such an incentive.

Consistent with the Duopoly Case model proposed in Case 2 of Appendix A, firms should decrease prices when they expect more of their competitors to be reducing prices in response to earnings management incentives, implying that β_3 (*IncentivesofOthers*) is predicted to be negative.

The results of these estimations are shown in Column 2 of Tables 3a and 3b, respectively. As predicted, the coefficient on β_3 is negative and significant in both model formulations. The average market share of firms who have incentive to boost earnings (when non-zero) is approximately just over 20% for both EPS and ACEF Targets. The coefficients therefore imply that firms reduce prices by an average of approximately 25% (β_3 = -2.472 in Column 2 Table 3a) and 5% (β_3 = -0.697 in Column 2 Table 3b) in periods when competitors are expected to manage earnings upwards in relation to prior year quarterly EPS targets or the ACEF Target respectively.

These results are consistent with the Duopoly Case model proposed in Case 2 of Appendix A as well as Hypothesis *H3*, that firms reduce prices when more of their competitors have incentive to do so.

4.5. Inventory Level Control Variables.

One potential alternative explanation for the above findings is that firms reduce prices to manage excess inventory levels rather than to manage earnings. Inventory levels are likely to be correlated to historic performance, giving rise to a correlated omitted variable problem.

The analysis is therefore repeated incorporating two proxies for the incentive to manage excess inventory as additional controls, one at the firm level and one at the product level.

The first measure used is defined as $InventoryChange_t = \left(\frac{Inventory_{t-1}}{Sales_{t-1}} - \frac{Inventory_{t-5}}{Sales_{t-5}}\right) \Big/ \frac{Inventory_{t-5}}{Sales_{t-5}}$.[45]

This measures the inventory change (in days sales) over the twelve months ending at the *beginning* of the quarter of interest. If prices fall in periods following upward spikes in inventory, a negative value for β_8, the coefficient on this variable in the following regression should be observed:

$$Ln\left(\frac{Price_{it}}{MaxPrice_i - Price_{it}}\right) = \alpha + \beta_1 JustBeatQEnd_{it} + \beta_2 JustMissQEnd_{it} + \beta_3 IncentivesofOthers_{it} + \beta_4 Ln\left(\frac{Price_{it-52}}{MaxPrice_i - Price_{it-52}}\right)$$
$$+\beta_5 JustBeatQEnd_{it-52} + \beta_6 JustMissQEnd_{it-52} + \beta_7 IncentivesofOthers_{it-52} + \beta_8 InventoryChange_{it-1} + \varepsilon_{it}$$

[45] Use of different inventory change measures (including dummies for specific ranges and contemporaneous effects) have varying explanatory power but do not materially change the significance of the other coefficients of interest in the regressions.

The results of these analyses are shown in Column 3 of Tables 3a and 3b and show that increases in inventory levels observed at the beginning of the quarter are associated with price increases ($\beta_8>0$).[46] However, neither of the other variables of interest (*JustBeatQEnd* and *JustMissQEnd*) are materially affected by the inclusion of this variable.

The *InventoryChange* variable is derived from quarterly data at the *corporate* level which is likely to be a noisy proxy for the incentive to manage product level inventory. A simple inventory prediction model is therefore developed to estimate incentive to manage excess inventory at the *product* level.

Expected sales volumes are estimated using the previously estimated model shown in Table 2 with additional fixed effects for each of the individual UPC codes in the sample:

$$Ln\left(WeeklyUnitsSold_{it}\right) = \alpha + \sum_{j=-1}^{1} \beta_j Ln\left(\frac{Price_{i,t+j}}{MaxPrice_i - Price_{i,t+j}}\right) + \sum_{j=1}^{12} \gamma_j Month_j + Ln\left(\frac{Price_{i,t}}{MaxPrice_i - Price_{i,t+j}}\right) * I + \sum_j \delta_j UPC_j + \varepsilon_{it}$$ [47]

where *UPC* are fixed effects for the different UPCs. The residuals can be considered as 'unexpected' sales and hence lagged residuals can be considered as a proxy for 'unexpected' inventory levels at the product level.[48]

The regression used to test *H3* above is refined by adding lagged *UnexpectedInventory* (scaled by annual sales) as additional control variables. If prices fall in periods of unexpectedly high inventory, a negative value for β_9, the coefficient on

[46] Positive but not-significant in Table 3b when considering ACEF Targets.
[47] I use the single period look forward/back model here as the two period anticipation model results in many lost observations and significantly weaker statistical significance. However, use of the two period look ahead / back model provides similar results with fewer observations. Use of one week look-back is also consistent with the minimum time required for firms to react and change prices within the system.
[48] I report results including one week's lagged residuals. Use of additional lags provides no material additional information.

UnexpectedInventory in the following regression should be observed:

$$Ln\left(\frac{Price_{it}}{MaxPrice_i - Price_{it}}\right) = \alpha + \beta_1 JustBeatQEnd_{it} + \beta_2 JustMissQEnd_{it} + \beta_3 IncentivesofOthers_{it} + \beta_4 Ln\left(\frac{Price_{it-52}}{MaxPrice_i - Price_{it-52}}\right)$$
$$+\beta_5 JustBeatQEnd_{it-52} + \beta_6 JustMissQEnd_{it-52} + \beta_7 IncentivesofOthers_{it-52} + \beta_9 UnexpectedInventory_{it-1} + \varepsilon_{it}$$

The results of these estimations with respect to EPS Targets and ACEF Targets are shown in Column 4 of Tables 3a and 3b, respectively. The coefficients on the main variables of interest (*JustBeatQEnd* and *JustMissQEnd*) are generally little changed by the addition of the inventory control variables.[49] This suggests that the results of the earlier analyses relating to Earnings Management incentives persist after controlling for inventory management incentives.

Additionally, they show the coefficient on *UnexpectedInventory* is not significantly different from zero (β_9=-4.898 for the EPS Target) and only significant at the 10% level (β_9=-6.157) for beating the ACEF Target.[50]

Overall, these results suggest that although there may be some relation between inventory and price, it appears that it is more complex than firms simply cutting prices to reduce excess inventory.

[49] Note that *JustMissQEnd* in the EPS Target case ceases to be significant in the EPS Target case and *JustBeatQEnd* becomes insignificant in the ACEF case. However, β_1 is still significantly different from β_2 in both models.

[50] One limitation of the analysis is the endogenous nature of the demand and price models relating to the use of anticipated prices ($Price_{t+1}$). Exclusion of these variables from the demand estimation model to eliminate this concern does not materially change the coefficients of interest here with the exception that the *UnexpectedInventory* variable ceases to be significantly different from zero in both model specifications.

4.6. Persistence of Price Discounting Behavior

Based on the simple examples presented in Section 2.4 above, including Case 3 of Appendix A, Hypothesis *H4* suggests that price reductions used at the end of a quarter to boost earnings temporarily are predicted to lead to earnings reductions in future years, creating greater incentive for subsequent price discounts.

Persistence in Earnings Management incentives may be tested in two ways. First, it implies there will be serial correlation in the likelihood of a firm just beating its EPS Target. Analysis of the data reveals no evidence of such serial correlation. However, this may be due to the lack of long time series data.

A second way to test for persistence in Earnings Management incentive is to examine of price discounting behavior at the end of reporting periods following those during which a firm just beat its EPS or ACEF Target. Although this effect may be present in the quarter immediately following, it is difficult to separate the calendar seasonality effects and the earnings management behavior using the sample data. Therefore, I consider the effect at the fiscal quarter-end twelve months after a firm just beat its EPS or ACEF Target. For this purpose, the results of the same analysis used to test Hypothesis *H2* presented in Table 3a and 3b are reused.

$$Ln\left(\frac{Price_{it}}{MaxPrice_i - Price_{it}}\right) = \alpha + \beta_1 JustBeatQEnd_{it} + \beta_2 JustMissQEnd_{it} + \beta_4 Ln\left(\frac{Price_{it-52}}{MaxPrice_i - Price_{it-52}}\right).$$
$$+\beta_5 JustBeatQEnd_{it-52} + \beta_6 JustMissQEnd_{it-52} + \varepsilon_{it}$$

However, the focus now is on the β_5 and β_6 coefficients relating to the incentives in the prior year, $JustBeatQEnd_{t-52}$ and $JustMissQEnd_{t-52}$, respectively.

The estimated coefficients on $JustBeatQEnd_{t-52}$ ($\beta_5 \approx$ -0.2 in all model specifications of Table 3a) are negative and significantly different from zero in all tests relating to the EPS Target. For the EPS Target, price reductions of 10% at the time of the earnings management incentive are followed by price reductions of 7.0% and 1.5% in the two subsequent years.[51] These effects are above and beyond the effects of any contemporaneous Earnings Management incentive for those years which are captured by the $JustBeatQEnd_t$ *or* $JustMissQEnd_t$ variables. Extending the model to incorporate the effects of the market share of other firms expected to be managing earnings from the previous year ($IncentivesofOthers_{t-52}$) are presented in Columns 2-4 of Table 3a and show a similar persistence trend in price discounting based upon competitor incentives.

Results relative to the ACEF Target are sensitive to the model specification and are shown in Table 3b. These show a strong response to the ($IncentivesofOthers_{t-52}$) variable consistent with competitors repeating (and increasing) discounts in response to prior year incentives (and behavior) of other firms in the industry. The reversion to regular prices is faster ($\beta_5 \approx$ -0.1 in Columns 2 and 3) than for the EPS Target but discounting still appears persistent. However, this effect becomes insignificant when controlling for *Unexpected Inventory* suggesting that the persistence of price discounting associated with prior year ACEF Targets is mediated by *UnexpectedInventory*. Although not tested here, it is possible that competitors reduce prices slightly earlier than the firm being studied. This in turn leads to an upward spike in *UnexpectedInventory* just prior to the end-of-quarter price cut and the results observed.

[51] This price evolution is shown in Figure 5 for a one-time Earnings Management Incentive in Year 3.

Overall, this evidence suggests that the price reductions associated with Earnings Management Incentives also affect pricing behavior twelve months later. Indeed, the results observed are highly consistent with the analytical model presented in Case 3 of Appendix A suggesting that firms may have incentive to offer discounts simply due to competitor beliefs that they will have repeating earnings acceleration incentives.

5. Conclusion

Using a new data set of supermarket scanner data, this paper considers the effects of price discounting on current and future period earnings and the relation of earnings management incentives to within-firm and competitors pricing behavior. The results show that the price elasticity of demand for soup allows firms to increase short-term earnings by discounting prices. However, consistent with customer stockpiling soup during the discount periods, there is a drop in demand following the return to regular pricing which reduces earnings in the following period. This subsequent reduction in earnings is material and may be as much as twice the benefit gained during the price promotion.

Consistent with analytical models of incentive-motivated behavior and also the survey evidence of Graham, Harvey and Rajgopal (2005), the evidence suggests that firms discount prices to meet prior year quarterly earnings as well as analyst expectations. Sample firms who just beat these targets reduced prices by an average of 10-15% in the final month of the fiscal quarter.

The results indicate that the effects of real earnings management are not restricted to firms with increased earnings management incentives. Tests of how competitors respond to the earnings management incentives of other firms in their industry show competitors reducing prices when more other firms within their industry have incentive to manage earnings. This effect is above and beyond the price reductions predicted based upon their own incentives.

Further, this price discounting behavior appears to be persistent. Although the data show no evidence of serial correlation in the likelihood of being classified as having strong earnings management incentives, price reductions associated with earnings management incentives around prior year EPS Targets are partially repeated twelve months with an initial 10% price reduction at the time of the earnings management incentive being followed by price reductions of 7% and 1.5% twelve and twenty-four months later.

Overall, these findings suggest that firms discount prices to achieve earnings benchmarks and indicate these actions span multiple reporting periods and also affect competitor pricing behavior.

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Appendix A – Analytical Model Showing How Discounting Incentives Can Lead to Price Discounting.

In this Appendix, I develop a general case model of customer demand and manufacturer pricing behavior and then consider a set of different scenarios.

Consider an industry that comprises two profit maximizing firms (α and β) facing a two-period competitive situation. These firms produce similar, partially substitutable commodities at marginal cost c for which the demand function d_{it} for each firm $i \in \{\alpha, \beta\}$ in period $t \in \{1,2\}$ is common knowledge and is given by:

$$d_{\alpha 1} = A - ap_{\alpha 1} + bp_{\alpha 2} + rp_{\beta 1} + sp_{\beta 2} \qquad d_{\alpha 2} = A - ap_{\alpha 2} + bp_{\alpha 1} + rp_{\beta 2} + sp_{\beta 1}$$

$$d_{\beta 1} = A - ap_{\beta 1} + bp_{\beta 2} + rp_{\alpha 1} + sp_{\alpha 2} \qquad d_{\beta 2} = A - ap_{\beta 2} + bp_{\beta 1} + rp_{\alpha 2} + sp_{\alpha 1}$$

where A, a, b, r & s are non-negative constants such that $a>b\geq 0$ & $r>s\geq 0$, $a>b+½(r+s)$ and p_{it} are the prices set by firm $i \in \{\alpha, \beta\}$ in period $t \in \{1,2\}$.

This demand model is designed to take account of the differing effects of price changes on customer purchase patterns evidenced proposed by Gupta (1988) and extended by Macé and Neslin (2004). Price reductions generate sales increases from three sources: increased overall consumption, inter-temporal switching of purchases (purchase deceleration and stockpiling) and brand switching.

The demand curve for each Player is downward sloping in their current period price (a>0). The positive value on b reflects the inter-temporal elasticity of demand representing switching purchases towards the lower priced period. This is consistent with the pre- and post-promotion dips in demand seen in Figures 1 and 2 as customers are able to time their purchases into periods of low prices. The positive value on r reflects the current period cross-product elasticity as one Player steals market share from the other by lowering prices. Similarly, the positive value on s reflects the elasticity across product and time. The relational restrictions on a, b, r and s are so that increases in prices result in reductions in overall demand. A further assumption that $A-(a-b-r-s)c>0$ ensures that demand is positive when all prices are equal to marginal cost.

Prices are announced simultaneously by the firms and are fully committed for the two periods.[52] The product is manufactured with a constant unit cost of production $c \geq 0$ resulting in profits for firm $i \in \{\alpha, \beta\}$ in period $t \in \{1,2\}$ of $\pi_{it} = d_{it}(p_{it} - c)$.

The manager of firm $i \in \{\alpha, \beta\}$ receives a bonus of $\lambda.\pi_{it}$ where $\lambda>0$ and, consistent with placing greater value on current (as opposed to future) earnings, discounts second period earnings by a factor δ_i such that $\frac{2a^2-b^2-2a\sqrt{a^2-b^2}}{b^2} < \delta_i \leq 1$. The lower bound on δ is required to ensure concavity of the profit functions for each Player. It gives a wide range of values δ with the lower bound equal to 0.072 if $b=½a$. Indeed, for the discount factor δ bounded below by 0.9 (representing a 10% discount of second period earnings), we would need b to be no higher than $0.9986a$.

[52] If prices are not committed, allowing resetting of prices at the end of the first period, the two-period sub-game perfect model can be solved using backward induction. All main results are similar to the ones given here unless otherwise noted.

To ensure that demand is non-negative in each period, δ is further restricted to the range satisfying $\frac{b\left(2(a+b)^2-(r-s)^2\right)}{4a^3+6a^2b+2b^3+a(r-s)^2} \le \delta \le 1$.

Case 1 - Monopoly

Restricting r = s = 0, the game simplifies to that of a single profit maximizing firm facing a two-period game. In this scenario, I show that a manager with incentive to discount second period earnings will:

A1.1 Select price $p_{\alpha 1}$ for the first period to be lower than second period price $p_{\alpha 2}$.

A1.2 Select price $p_{\alpha 1}$ for the first period to be lower than the optimal price had there been no discounting of future earnings ($p_{\alpha 1}^{nodisc}$). Similarly, price $p_{\alpha 2}$ for the second period will be higher than the optimal price had there been no discounting of future earnings ($p_{\alpha 2}^{nodisc}$).

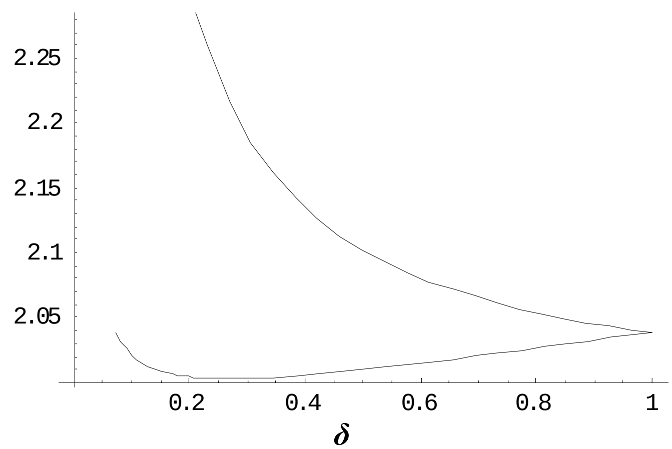
A1.3 The consequence of the previous conclusion is that profits in the first (second) period will be higher (lower) than they would have been without any incentive to discount future earnings.

A1.4 Additionally, the sum of the profits for the two periods will be lower than they would have been without any incentive to discount future earnings.[53]

[53] In the no commitment game, $p_{\alpha 1} \ge p_{\alpha 2}$. Additionally, $p_{\alpha 1} \le p_{\alpha 1}^{nodisc}$ and $p_{\alpha 2} \le p_{\alpha 2}^{nodisc}$ with A1.3 and A1.4 unchanged.

The idea that the firm can take an action (in this case reducing prices in period one) which is beneficial in the short-run but has a longer-term cost overall is similar to the idea of "myopic behavior" proposed by Stein (1989) or "borrowing of future earnings" discussed by Degeorge, Patel and Zeckhauser (1999). These papers conclude that managers will behave myopically, generating additional current period income by 'borrowing' against next period's earnings.

Example of how price $p_{\alpha 1}$ (lower line) and $p_{\alpha 2}$ (higher line) vary with δ.



Proof of A1.1

Demand is given by: $d_{\alpha 1} = A - ap_{\alpha 1} + bp_{\alpha 2}$ and $d_{\alpha 2} = A - ap_{\alpha 2} + bp_{\alpha 1}$

This leads the manager to solve the following problem:

$$\underset{p_{\alpha 1}, p_{\alpha 2}}{Max}\left[d_{\alpha 1}\left(p_{\alpha 1} - c\right) + \delta . d_{\alpha 2}\left(p_{\alpha 2} - c\right)\right]$$

Simple first order conditions give us the result that the player will select prices:

$$p_{\alpha 1}=\frac{2a\left(A+ac\right)\delta-b^2c\left(1+\delta\right)+b\delta\left(A+ac+A\delta-ac\delta\right)}{4a^2\delta-b^2\left(1+\delta\right)^2}$$ and

$$p_{\alpha 2}=\frac{A\left(b+2a\delta+b\delta\right)+c\left(ab\left(\delta-1\right)+2a^2\delta-b^2\delta\left(1+\delta\right)\right)}{4a^2\delta-b^2\left(1+\delta\right)^2}$$

Checking Second Order Conditions

$$f_{p_{\alpha 1}p_{\alpha 1}}=\frac{d^2}{dp_{\alpha 1}^2}\left[d_{\alpha 1}\left(p_{\alpha 1}-c\right)+\delta d_{\alpha 2}\left(p_{\alpha 2}-c\right)\right]=-2a<0,$$

$$f_{p_{\alpha 2}p_{\alpha 2}}=\frac{d^2}{dp_{\alpha 2}^2}\left[d_{\alpha 1}\left(p_{\alpha 1}-c\right)+\delta d_{\alpha 2}\left(p_{\alpha 2}-c\right)\right]=-2a\delta<0,$$

$$f_{p_{\alpha 1}p_{\alpha 2}}=\frac{d^2}{dp_{\alpha 1}p_{\alpha 2}}\left[d_{\alpha 1}\left(p_{\alpha 1}-c\right)+\delta d_{\alpha 2}\left(p_{\alpha 2}-c\right)\right]=b\left(1+\delta\right)^2$$

$$f_{p_{\alpha 1}p_{\alpha 1}}f_{p_{\alpha 2}p_{\alpha 2}}-f_{p_{\alpha 1}p_{\alpha 2}}^2=4a^2\delta-b^2\left(1+\delta\right)^2>0 \text{ when } \frac{2a^2-b^2-2a\sqrt{a^2-b^2}}{b^2}<\delta_i\le 1.$$

This means that the first period price $p_{\alpha 1}$ will be lower than second period price $p_{\alpha 2}$.

$$p_{\alpha 1}-p_{\alpha 2}=\frac{b\left(A-ac+bc\right)\left(\delta^2-1\right)}{4a^2\delta-b^2\left(1+\delta\right)^2}\le 0 \text{ with equality only if } \delta=1.$$

$A>\left(a-b\right)c$ and $\delta\le 1$ means the numerator is negative and zero only if $\delta=1$. The denominator is positive across the range $\frac{2a^2-b^2-2a\sqrt{a^2-b^2}}{b^2}<\delta_i\le 1$, since $a>b$. Therefore $p_{\alpha 1}\le p_{\alpha 2}$ with equality only if $\delta = 1$.

Proof of A1.2

Restricting δ to the range $\frac{b\left(2(a+b)^2-(r-s)^2\right)}{4a^3+6a^2b+2b^3+a(r-s)^2}=\frac{b}{2a-b}\leq\delta\leq 1$, the first period price, $p_{\alpha 1}$, will be lower than the optimal price had there been no discounting of future earnings, $p_{\alpha 1}\leq p_{\alpha 1}^{nodisc}=\frac{1}{2}\left(\frac{A}{a-b}+c\right)$.

The proof proceeds as follows: Initially show that second period demand is zero when $\delta=\frac{b}{2a-b}$. Then show that $p_{\alpha 1}=p_{\alpha 1}^{nodisc}$ if and only if $\delta=\frac{b}{2a-b}$ or $\delta=1$. Then show that the price $p_{\alpha 1}$ is continuous across this range of δ such that

$\left.\frac{d}{d\delta}p_{\alpha 1}\right|_{\delta=1}=\frac{b(A-ac+bc)}{4\left(a^2-b^2\right)}>0$. Therefore $p_{\alpha 1}\leq p_{\alpha 1}^{nodisc}$ for $\frac{b}{2a-b}\leq\delta\leq 1$.

Proof of A1.3

These prices lead to higher profits (π) in the first period and lower profits in the second than those which would be observed without any discounting of future earnings.

When $\delta=1$, $\pi_{\alpha 1}^{nodisc}-\pi_{\alpha 1}=0$,

$\frac{d}{d\delta}\left(\pi_{\alpha 1}^{nodisc}-\pi_{\alpha 1}\right)=\frac{2b^2\delta(a+b)\left(A-(a-b)c\right)^2\left(4a^2\left(1+\delta^3\right)-b^2(1+\delta)^3\right)}{\left(4a^2\delta-b^2(1+\delta)^2\right)^3}\geq 0$ provided

$\frac{2a^2-b^2-2a\sqrt{a^2-b^2}}{b^2}<\delta_i\leq 1$. Further, $\frac{d}{d\delta}\left(\pi_{\alpha 1}^{nodisc}-\pi_{\alpha 1}\right)=\frac{b^2\left(A-(a-b)c\right)^2}{4\left(a^2-b^2\right)(a+b)}>0$ when $\delta=1$.

When $\delta = 1$, $\pi_{\alpha 2}^{nodisc} - \pi_{\alpha 2} = 0$,

$$\frac{d}{d\delta}\left(\pi_{\alpha 2}^{nodisc} - \pi_{\alpha 2}\right) = \frac{2b^2\delta\left(a+b\right)\left(A-\left(a-b\right)c\right)^2\left(4a^2\left(1+\delta^3\right)-b^2\left(1+\delta\right)^3\right)}{\left(-4a^2\delta+b^2\left(1+\delta\right)^2\right)^3} \leq 0$$

if $\dfrac{2a^2-b^2-2a\sqrt{a^2-b^2}}{b^2} < \delta_i \leq 1$. Further, $\dfrac{d}{d\delta}\left(\pi_{\alpha 2}^{nodisc} - \pi_{\alpha 2}\right) = -\dfrac{b^2\left(A-\left(a-b\right)c\right)^2}{4\left(a^2-b^2\right)^2\left(a+b\right)} < 0$

when $\delta = 1$.

Proof of A1.4

Total profits over the two periods when there is incentive to discount will be lower than total profits over the two periods had there been no incentive to discount.

$$\pi_{\alpha 1}^{nodisc} + \pi_{\alpha 2}^{nodisc} - \pi_{\alpha 1} - \pi_{\alpha 2} = \frac{b^2\left(A-\left(a-b\right)c\right)^2\left(1-\delta\right)^2\left(2a^2\left(1+\delta^2\right)-b^2\left(1+\delta\right)^2\right)}{2\left(a-b\right)\left(4a^2\delta-b^2\left(1+\delta\right)^2\right)^2} \geq 0$$

provided that $\dfrac{2a^2-b^2-2a\sqrt{a^2-b^2}}{b^2} < \delta_i \leq 1$.

Case 2 – Duopoly with Player 2 Having No Incentive to Discount Future Earnings

Restricting $\delta_\beta = 1$, I consider the behavior of Player β who has no personal incentive to discount second period earnings. In this scenario, I show that Player β will

A2.1 Select price $p_{\beta 1}$ for the first period to be lower than second period price $p_{\beta 2}$.

A2.2 Select price $p_{\beta 1}$ for the first period to be lower than the optimal price had there been no discounting of future earnings by Player α ($p_{\beta 1}^{nodisc}$) if demand must be non-negative in both periods. Similarly, price $p_{\beta 2}$ for the second period will be higher than the optimal price had there been no discounting of future earnings ($p_{\beta 2}^{nodisc}$).

A2.3 The sum of the profits for Player β over the two periods will be *higher* than they would have been without any incentive to discount future earnings. This somewhat surprising result is caused by Player α's commitment to increase second period prices by more than she reduces first period prices. This allows Player β to increase mean prices and raise profits.[54]

For presentation, I shall assume $\delta_\alpha = \delta$ is common knowledge.

Proof of A2.1

Demand is given by:

$$d_{\alpha 1} = A - ap_{\alpha 1} + bp_{\alpha 2} + rp_{\beta 1} + sp_{\beta 2} \qquad d_{\alpha 2} = A - ap_{\alpha 2} + bp_{\alpha 1} + rp_{\beta 2} + sp_{\beta 1}$$

$$d_{\beta 1} = A - ap_{\beta 1} + bp_{\beta 2} + rp_{\alpha 1} + sp_{\alpha 2} \qquad d_{\beta 2} = A - ap_{\beta 2} + bp_{\beta 1} + rp_{\alpha 2} + sp_{\alpha 1}$$

This leads the managers to solve the following problems simultaneously to generate their best responses:

$\underset{p_{\alpha 1}, p_{\alpha 2}}{Max}\, E\left[d_{\alpha 1}\left(p_{\alpha 1} - c\right) + \delta . d_{\alpha 2}\left(p_{\alpha 2} - c\right)\right]$ and $\underset{p_{\beta 1}, p_{\beta 2}}{Max}\, E\left[d_{\beta 1}\left(p_{\beta 1} - c\right) + d_{\beta 2}\left(p_{\beta 2} - c\right)\right]$.

[54] In the no commitment game, $p_{\alpha 1} \geq p_{\alpha 2}$, $p_{\beta 1} \geq p_{\beta 2}$. Additionally, $p_{\alpha 1} \leq p_{\alpha 1}^{nodisc}$, $p_{\alpha 2} \leq p_{\alpha 2}^{nodisc}$, $p_{\beta 1} \leq p_{\beta 1}^{nodisc}$ and $p_{\beta 2} \leq p_{\beta 2}^{nodisc}$ with both Players suffering a reduction in total profits if $\delta<1$.

First Order Conditions provide a Nash Equilibrium with reaction curves defined by:

Player α selecting prices $p_{\alpha 1}$ and $p_{\alpha 2}$ in the two periods such that:

$$p_{\alpha 1} = \frac{\left(2a^2\delta - b^2\left(1+\delta\right) + ab\delta\left(1-\delta\right)\right)c + 2a\delta\left(A + r.p_{\beta 1} + s.p_{\beta 2}\right) + b\delta\left(1+\delta\right)\left(A + r.p_{\beta 2} + s.p_{\beta 1}\right)}{4a^2\delta - b^2\left(1+\delta\right)^2}$$ and

$$p_{\alpha 2} = \frac{\left(2a^2\delta - b^2\delta\left(1+\delta\right) + a\delta\left(1-\delta\right)\right)c + 2a\delta\left(A + r.p_{\beta 2} + s.p_{\beta 1}\right) + b\left(1+\delta\right)\left(A + r.p_{\beta 1} + s.p_{\beta 2}\right)}{4a^2\delta - b^2\left(1+\delta\right)^2}$$; and

Player β selecting prices $p_{\beta 1}$ and $p_{\beta 2}$ such that

$$p_{\beta 1} = \frac{a^2c + b\left(A - bc + r.p_{\alpha 2} + s.p_{\alpha 1}\right) + a\left(A + r.p_{\alpha 1} + s.p_{\alpha 2}\right)}{2\left(a^2 - b^2\right)}$$ and

$$p_{\beta 2} = \frac{a^2c + b\left(A - bc + r.p_{\alpha 1} + s.p_{\alpha 2}\right) + a\left(A + r.p_{\alpha 2} + s.p_{\alpha 1}\right)}{2\left(a^2 - b^2\right)}$$

Checking Second Order Conditions for Player α:

$$f_{p_{\alpha 1}p_{\alpha 1}} = \frac{d^2}{dp_{\alpha 1}^2}\left[d_{\alpha 1}\left(p_{\alpha 1} - c\right) + \delta d_{\alpha 2}\left(p_{\alpha 2} - c\right)\right] = -2a < 0,$$

$$f_{p_{\alpha 2}p_{\alpha 2}} = \frac{d^2}{dp_{\alpha 2}^2}\left[d_{\alpha 1}\left(p_{\alpha 1} - c\right) + \delta d_{\alpha 2}\left(p_{\alpha 2} - c\right)\right] = -2a\delta < 0,$$

$$f_{p_{\alpha 1}p_{\alpha 2}} = \frac{d^2}{dp_{\alpha 1}p_{\alpha 2}}\left[d_{\alpha 1}\left(p_{\alpha 1} - c\right) + \delta d_{\alpha 2}\left(p_{\alpha 2} - c\right)\right] = b\left(1+\delta\right),$$

$$f_{p_{\alpha 1}p_{\alpha 1}}f_{p_{\alpha 2}p_{\alpha 2}} - f_{p_{\alpha 1}p_{\alpha 2}}^2 = 4a^2\delta - b^2\left(1+\delta\right)^2 > 0 \text{ provided that } \frac{2a^2 - b^2 - 2a\sqrt{a^2 - b^2}}{b^2} < \delta \leq 1$$

Checking Second Order Conditions for Player β:

$$f_{p_{\beta 1}p_{\beta 1}} = \frac{d^2}{dp_{\beta 1}^2}\left[d_{\beta 1}\left(p_{\beta 1} - c\right) + d_{\beta 2}\left(p_{\beta 2} - c\right)\right] = -2a < 0,$$

$$f_{p_{\beta 2}p_{\beta 2}} = \frac{d^2}{dp_{\beta 2}^2}\left[d_{\beta 1}\left(p_{\beta 1}-c\right)+d_{\beta 2}\left(p_{\beta 2}-c\right)\right] = -2a < 0,$$

$$f_{p_{\beta 1}p_{\beta 2}} = \frac{d^2}{dp_{\beta 1}p_{\beta 2}}\left[d_{\beta 1}\left(p_{\beta 1}-c\right)+d_{\beta 2}\left(p_{\beta 2}-c\right)\right] = 2b$$

$$f_{p_{\beta 1}p_{\beta 1}}f_{p_{\beta 2}p_{\beta 2}} - f_{p_{\beta 1}p_{\beta 2}}^2 = 4a^2 - 4b^2 > 0 \text{ since } a>b$$

As with the monopoly case discussed above, Player α reduces prices in the first period below those in the second: $p_{\alpha 1} - p_{\alpha 2} \leq 0$.

$p_{\alpha 1} - p_{\alpha 2}$ is continuous across the range $\frac{2a^2 - b^2 - 2a\sqrt{a^2-b^2}}{b^2} < \delta \leq 1$ and equals zero if and only if $\delta = 1$ with the previously stated restrictions on *a, b, r* and *s* ensuring that

$$\frac{d}{d\delta}\left(p_{\alpha 1} - p_{\alpha 2}\right)\Big|_{\delta=1} = \frac{4b(a+b)\left(A+c(-a+b+r+s)\right)}{8a^3 - 8b^3 + 2b(r-s)^2 - 4b^2(r+s) + (r-s)^2(r+s) + a^2\left(8b - 4(r+s)\right) - 2a\left(4b^2 + (r-s)^2 + 4b(r+s)\right)} > 0$$

In spite of having no individual incentive to discount, Player β also simultaneously selects prices such that $p_{\beta 1} - p_{\beta 2} \leq 0$.

$$p_{\beta 1} - p_{\beta 2} = \frac{a^2c + b\left(A - bc + r.p_{\alpha 2} + s.p_{\alpha 1}\right) + a\left(A + r.p_{\alpha 1} + s.p_{\alpha 2}\right)}{2\left(a^2 - b^2\right)} - \frac{a^2c + b\left(A - bc + r.p_{\alpha 1} + s.p_{\alpha 2}\right) + a\left(A + r.p_{\alpha 2} + s.p_{\alpha 1}\right)}{2\left(a^2 - b^2\right)}$$

$$= \frac{(a-b)(r-s)\left(p_{\alpha 1} - p_{\alpha 2}\right)}{2\left(a^2 - b^2\right)} \leq 0 \text{ provided that } p_{\alpha 1} - p_{\alpha 2} \leq 0$$

Proof of A2.2

When we include the restriction on δ which results in non-negative demand, the first (second) period price which Player β charges is lower (higher) than she would have charged had there been no incentive for Player α to discount second period earnings (if δ_α=1). $p_{\beta 1} \leq p_{\beta 1}^{nodisc} = p_{\beta 2}^{nodisc} \leq p_{\beta 2}$

We have shown above that $p_{\alpha 1} \leq p_{\alpha 2}$ and $p_{\beta 1} \leq p_{\beta 2}$. When considering δ such that $\frac{b\left(2(a+b)^2-(r-s)^2\right)}{4a^3+6a^2b+2b^3+a(r-s)^2} \leq \delta \leq 1$ and the other restrictions on *a, b, r* and *s,* the first period price is lower than the price had their been no discount.

$$p_{\beta 1} - p_{\beta 1}^{nodisc} = \frac{a^2c + b\left(A - bc + r.p_{\alpha 2} + s.p_{\alpha 1}\right) + a\left(A + r.p_{\alpha 1} + s.p_{\alpha 2}\right)}{2\left(a^2 - b^2\right)} - \frac{A + ac - bc}{2a - 2b - r - s} \leq 0$$

Provided that $\frac{4a^2s+2ab(3r-s)+(r-s)\left(-2b^2+s(r+s)\right)}{4a^2r+2ab(3s-r)-(r-s)\left(-2b^2+s(r+s)\right)} \leq \delta$ and it is easily shown that

$$\frac{4a^2s+2ab(3r-s)+(r-s)\left(-2b^2+s(r+s)\right)}{4a^2r+2ab(3s-r)-(r-s)\left(-2b^2+s(r+s)\right)} \leq \frac{b\left(2(a+b)^2-(r-s)^2\right)}{4a^3+6a^2b+2b^3+a(r-s)^2}.$$

For values of δ lower than this range, we observe Player α setting prices as if it were a one period game. In this case, prices for Player β will be exactly as if there was no discounting.

Proof of A2.3

$$\pi_{\beta 1} + \pi_{\beta 2} - \pi_{\beta 1}^{nodisc} - \pi_{\beta 2}^{nodisc} \geq 0.$$

Start by holding Player β prices constant at $\hat{p}_{\beta 1}$, the price which Player β would have charged had there been no discounting of earnings.

$$\pi_{\beta 1}+\pi_{\beta 2}-\pi_{\beta 1}^{nodisc}-\pi_{\beta 2}^{nodisc}=\left(\left(r.p_{\alpha 1}+s.p_{\alpha 2}+r.p_{\alpha 2}+s.p_{\alpha 1}\right)-\left(r.p_{\alpha 1}^{nodisc}+s.p_{\alpha 2}^{nodisc}+r.p_{\alpha 2}^{nodisc}+s.p_{\alpha 1}^{nodisc}\right)\right).\hat{p}_{\beta 1}$$
$$=\left(r+s\right)\left(p_{\alpha 1}+p_{\alpha 2}-p_{\alpha 1}^{nodisc}-p_{\alpha 2}^{nodisc}\right).\hat{p}_{\beta 1}.$$

However, the mean price for Player α over the two periods increases as δ becomes smaller. As such, the change in profits must be positive since Player β can always choose other prices which would make it more positive.

Case 3 – Duopoly with Player 2 Having No Incentive to Discount Future Earnings but Believing that Player 1 has Some Incentive

The model is set up as with Case 2 with Player β having no incentive to discount second period earnings. In this version, I assume that δ_α is *not* common information. Instead, I assume that δ_α is known to Player α before she chooses prices but unknown to player β. Player β believes that $\delta_\alpha=\delta$ with probability ξ and $\delta_\alpha=1$ with probability 1-ξ. This means that Player β believes that Player α will have incentive to discount future earnings with some non-zero probability.

In this setting I show that Player α, will reduce prices in the first period even when she has no personal incentive to discount future earnings. Such price discounting is in response to expected price cuts of her competitor which are driven by Player β's belief that Player α will have incentive to discount future earnings with non-zero probability.

First Order Conditions provide reaction curves for Player α as follows: [55]

[55] Second Order Conditions are satisfied as before for Player α provided that $\frac{b\left(2\left(a+b\right)^2-\left(r-s\right)^2\right)}{4a^3+6a^2b+2b^3+a\left(r-s\right)^2}\leq\delta\leq 1$.

i) If there is no incentive to discount (δ_α=1), then she will react in a similar way to Player β in the previous case and will select prices $p_{\alpha 1}^{nodisc}$ and $p_{\alpha 2}^{nodisc}$ for the two periods such that:

$$p_{\alpha 1}^{nodisc} = \frac{\left(a^2 - b^2\right)c + b\left(A + r.p_{\beta 2} + s.p_{\beta 1}\right) + a\left(A + r.p_{\beta 1} + s.p_{\beta 2}\right)}{2\left(a^2 - b^2\right)}$$ and

$$p_{\alpha 2}^{nodisc} = \frac{\left(a^2 - b^2\right)c + b\left(A + r.p_{\beta 1} + s.p_{\beta 2}\right) + a\left(A + r.p_{\beta 2} + s.p_{\beta 1}\right)}{2\left(a^2 - b^2\right)}.$$

ii) In contrast, if Player α has discount $\delta_\alpha = \delta$, then she will select prices $p_{\alpha 1}^{disc}$ and $p_{\alpha 2}^{disc}$ in the two periods such that:

$$p_{\alpha 1}^{disc} = \frac{\left(2a^2\delta - b^2\left(1+\delta\right) + ab\delta\left(1-\delta\right)\right)c + 2a\delta\left(A + r.p_{\beta 1} + s.p_{\beta 2}\right) + b\delta\left(1+\delta\right)\left(A + r.p_{\beta 2} + s.p_{\beta 1}\right)}{4a^2\delta - b^2\left(1+\delta\right)^2}$$ and

$$p_{\alpha 2}^{disc} = \frac{\left(2a^2\delta - b^2\delta\left(1+\delta\right) + a\delta\left(1-\delta\right)\right)c + 2a\delta\left(A + r.p_{\beta 2} + s.p_{\beta 1}\right) + b\left(1+\delta\right)\left(A + r.p_{\beta 1} + s.p_{\beta 2}\right)}{4a^2\delta - b^2\left(1+\delta\right)^2}$$

If Player β believes that δ_α=δ with probability ξ and δ_α=1 with probability 1-ξ then to maximize expected profit, player 2 will solve First Order Conditions for $p_{\beta 1}$ and $p_{\beta 2}$ to satisfy:[56]

$$\frac{d}{dp_{\beta 1}}\left(\left[\xi\left(\pi_{\beta 1} + \pi_{\beta 2}\right)\Big|_{p_{\alpha 1}=p_{\alpha 1}^{disc},\,p_2=p_{\alpha 2}^{disc}}\right] + \left[\left(1-\xi\right)\left(\pi_{\beta 1} + \pi_{\beta 2}\right)\Big|_{p_{\alpha 1}=p_{\alpha 1}^{nodisc},\,p_{\alpha 2}=p_{\alpha 1}^{nodisc}}\right]\right) = 0$$
$$\frac{d}{dp_{\beta 2}}\left(\left[\xi\left(\pi_{\beta 1} + \pi_{\beta 2}\right)\Big|_{p_{\alpha 1}=p_{\alpha 1}^{disc},\,p_2=p_{\alpha 2}^{disc}}\right] + \left[\left(1-\xi\right)\left(\pi_{\beta 1} + \pi_{\beta 2}\right)\Big|_{p_{\alpha 1}=p_{\alpha 1}^{nodisc},\,p_{\alpha 2}=p_{\alpha 1}^{nodisc}}\right]\right) = 0$$

[56] Second order conditions are satisfied for Player β provided that $a>b$.

Solving these simultaneously, we obtain the Nash Equilibrium solution which provides $p_{\beta 1} \le p_{\beta 2}$, $p_{\alpha 1}^{nodisc} \le p_{\alpha 2}^{nodisc}$ and $p_{\alpha 1} \le p_{\alpha 2}$ that prices for both players in the first period are always lower than they are in the second.[57,58]

Further, the price which Player α charges even when having no incentive to discount, $p_{\alpha 1}^{nodisc}$ is less than $\dfrac{A+(a-b)c}{2a-2b-r-s}$, the price which Player α would have charged if Player *β* had correctly assumed there was no incentive to discount, provided that

$$\xi < \frac{-\left(\left(-4a^2\delta+b^2(1+\delta)^2\right)\left(-8ab^2\left(r^2-4rs+s^2\right)-2a\left(-(r-s)^2(r+s)^2+8b^2\left(r^2-rs+s^2\right)\right)\delta+b(2b-r-s)(r-s)^2(2b+r+s)(1+\delta)-8a^3\left(-2rs+\left(r^2+s^2\right)\delta\right)+4a^2b\left(r^2(5+\delta)+s^2(5+\delta)-2rs(1+5\delta)\right)\right)\right)}{\left(b(r-s)(r+s)^2\left(2abs(\delta-1)\delta+4a^2\delta\left(r+s(\delta-2)-r\delta\right)+b^2(1+\delta)\left(-r+s+2s\delta+(r-s)\delta^2\right)\right)\right)}$$

Considering the limit on ξ in the setting where the current period price set by one player does not affect demand of a competitor's product in the other period (*s=0*). This permits ξ to take any value between 0 and 1 provided that $\dfrac{b\left(10a^2-4ab+2b^2-r^2\right)}{4a^3-2a^2b-2b^3+a\left(8b^2-r^2\right)}<\delta$, a bound which is which is strictly decreasing in *r*, the size of the effect on the competitors sales for a given price change. As δ decreases below this range, the constraint becomes binding upon ξ. As *s* increases, the limits become slightly more restrictive. However, there is always some value of k such that ξ can take any value between 0 and 1 for all *δ* such that *0≤k<δ<1*.

[57] Proofs follow similar logic to previous section.

[58] In the no commitment game, $p_{\alpha 1} \ge p_{\alpha 2}$, $p_{\beta 1} \ge p_{\beta 2}$. Additionally, $p_{\alpha 1} \le p_{\alpha 1}^{nodisc}$, $p_{\alpha 2} \le p_{\alpha 2}^{nodisc}$, $p_{\beta 1} \le p_{\beta 1}^{nodisc}$ and $p_{\beta 2} \le p_{\beta 2}^{nodisc}$ with both Players suffering a reduction in total profits if *δ<1* for all values of ξ between zero and one.

The results mean that both players will set prices lower in the first period than the second. Further, under certain circumstances, Player α will reduce prices in the first period when she has no explicit incentive to do so below the optimal price had Player β known than there was no earnings management incentive.

Although not studied here, the role of competitor beliefs in the pricing decisions of Player α suggests that there may be a potentially beneficial role for mechanisms which permit pre-commitment of prices and public release of management forecasts which, if credible, should change competitors' beliefs about the likely actions a firm will take.

Appendix B – The Effects on Profitability of Price Reductions

In these calculations, I use a regression model similar to the one presented in Column 5 of Table 2 but with the simple scaling of *Price* by *MaxPrice*[59] to estimate the effect on demand of a price change as follows:

$$Ln\left(WeeklyUnitsSold_{it}\right) = \alpha + \sum_{j=-2}^{2} \beta_j Ln\left(\frac{Price_{i,t+j}}{MaxPrice_i}\right) + \beta_3 Ln\left(\frac{Price_{i,t}}{MaxPrice_i}\right) * I + \sum_{j=1}^{12} \gamma_j Month_j + \varepsilon_{it}$$

This results in the following coefficient estimates and the graphics shown in Figures 1 and 2.

Ln($Price_{t-2}$/*MaxPrice*) β_{-2}	0.095
Ln($Price_{t-1}$/*MaxPrice*) β_{-1}	0.419
Ln($Price_{t}$/*MaxPrice*) β_{0}	-1.602
Ln($Price_{t+1}$/*MaxPrice*) β_{1}	-0.155
Ln($Price_{t+2}$/*MaxPrice*) β_{2}	0.155
Indicator Ln*($Price_{t}$/*MaxPrice*) β_{3}	-0.715
Constant	0.924

The Effects of a 15% Price Reduction Lasting One Week

For a one-week 15% price reduction in week *t=4*, with prices falling from 1.00 to 0.85.

Week	1	2	3	4	5	6	7
Price *p*	1.00	1.00	1.00	**0.85**	1.00	1.00	1.00
Demand *v*	2.52	2.46	2.58	3.27	2.35	2.48	2.52
Revenue = *p * v*	2.52	2.46	2.58	2.78	2.35	2.48	2.52
Contribution = *(p-c1)*v*	1.65	1.60	1.69	1.64	1.54	1.62	1.65
Cumulative Change in Contribution from Constant Price (with *c=c1*)	0.00	-0.04	0.00	0.00	-0.11	-0.13	-0.13
Contribution = *(p-c2)*v*	2.06	2.01	2.11	2.18	1.92	2.03	2.06
Cumulative Change in Contribution from Constant Price (with *c=c2*)	0.00	-0.05	0.00	0.12	-0.01	-0.04	-0.04
Contribution = *(p-c3)*v*	2.26	2.20	2.32	2.44	2.11	2.23	2.26
Cumulative Change in Contribution from Constant Price (with *c=c3*)	0.00	-0.06	0.00	0.18	0.03	0.00	0.00

Where *c1*=34.7%, *c2*=18.2% and *c3*=10.3% of regular price. These figures are chosen so that cumulative change in contribution is zero *if c=c1*, cumulative change in contribution is 0.5% of quarterly contribution up to the end of the promotion if *c=c2* and the overall cost of the promotion is zero if *c=c3*

[59] The simplified scaling of the variable is used here to facilitate interpretation.

Quarterly 'contribution' can be increased by 0.5%, Gross Profit increased by 0.6% and EPS increased by 2.5% if marginal costs are 18.2%, gross margin is 68.1% and net margin is 16.4%.[60]

Cumulative Change in Contribution = 0.12 = 0.5%* (1 - 18.2%) * 2.52 * 12.
Cumulative Change in Gross Margin = 0.12 = 0.6% * 68.1% * 2.52 * 12.
Cumulative Change in EPS = 0.12 = 2.5% * 16.4% * 2.52 * 12.

The Effects of a 15% Price Reduction Lasting Two Weeks

For a two-week 15% price reduction in weeks *t=4* and *t=5*, with prices falling from 1.00 to 0.85

Week	1	2	3	4	5	6	7	8
Price *p*	1.00	1.00	1.00	**0.85**	**0.85**	1.00	1.00	1.00
Demand *v*	2.52	2.46	2.52	3.35	3.05	2.32	2.48	2.52
Revenue = *p * v*	2.52	2.46	2.52	2.85	2.60	2.32	2.48	2.52
Contribution = *(p-c4)*v*	1.65	1.60	1.65	1.69	1.54	1.51	1.62	1.65
Cumulative Change in Contribution from Constant Price (with *c=c4*)	0.00	-0.04	-0.04	0.00	-0.11	-0.24	-0.27	-0.27
Contribution = *(p-c5)*v*	2.05	2.00	2.05	2.22	2.02	1.88	2.02	2.05
Cumulative Change in Contribution from Constant Price (with *c=c5*)	0.00	-0.05	-0.05	0.12	0.10	-0.07	-0.10	-0.10
Contribution = *(p-c6)*v*	2.28	2.22	2.28	2.53	2.30	2.09	2.24	2.28
Cumulative Change in Contribution from Constant Price (with *c=c6*)	0.00	-0.06	-0.06	0.19	0.22	0.04	0.00	0.00

Where *c4*=34.7%, *c5*=18.2% and *c6*=9.7% of regular price. These figures are chosen so that cumulative change in contribution through the end of the promotion is zero *if c=c4*, cumulative change in contribution is 0.5% of quarterly contribution up to the end of the promotion if *c=c5* and the overall cost of the promotion is zero if *c=c6*

Quarterly 'contribution' can be increased by 0.5%, Gross Profit increased by 0.6% and EPS increased by 2.5% if marginal costs are 18.7%, gross margin is 67.7% and net margin is 16.3%.[61]

Cumulative Change in Contribution = 0.12 = 0.5%* (1 - 18.7%) * 2.52 * 12.
Cumulative Change in Gross Margin = 0.12 = 0.6% * 67.7% * 2.52 * 12.
Cumulative Change in EPS = 0.12 = 2.5% * 16.3% * 2.52 * 12.

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[60] Note: These changes are highly sensitive to changes in assumption on margins and operating leverage.
[61] Note: These changes are highly sensitive to changes in assumption on margins and operating leverage.

Appendix C – Variable Definitions

IncentivesofOthers measures the dollar market share in the relevant month (excluding product *i*) of firms with *JustBeatQEnd* equaling one.

$IncentivesofOthers_{t-52}$ is a variable which equals the value of *IncentivesofOthers* one year prior to the observation.

Indicator is a dummy variable equal to one if $Price_{i,t-1} < Price_{i,t}$ and zero otherwise.

Inventory is the level of Inventory at the end of the quarter as stated in the corporation's SEC filings.

$Inventory_{t-1}$ is the level of Inventory at the end of the preceding fiscal quarter as stated in the corporation's SEC filings.

$Inventory_{t-5}$ is a variable which equals the value of $Inventory_{t-1}$ one year prior to the observation.

$$InventoryChange_t = \left(\frac{Inventory_{t-1}}{Sales_{t-1}} - \frac{Inventory_{t-5}}{Sales_{t-5}} \right) \Big/ \frac{Inventory_{t-5}}{Sales_{t-5}}$$

$Inventory\ Change_{t-52}$ is a variable which equals the value of *Inventory Change* one year prior to the observation.

JustBeatQEnd is a dummy variable which equals one if the quarterly EPS for the manufacturing firm is 0-5% above a) the EPS figure from the same quarter in the previous year; or b) the Consensus Earnings Forecasts obtained as the mean forecast for the quarter estimated by analysts over the period 30-60 days prior to the end of the quarter, and the sale occurs in the last month of the manufacturer's fiscal quarter, zero otherwise.

$JustBeatQEnd_{t-52}$ is a variable which equals the value of *JustBeatQnd* one year prior to the observation.

JustMissQEnd is a dummy variable which equals one if the quarterly EPS for the manufacturing firm is 0-5% below a) EPS figure from the same quarter in the previous year; or b) the Consensus Earnings Forecasts obtained as the mean forecast for the quarter estimated by analysts over the period 30-60 days prior to the end of the quarter, and the sale occurs in the last month of the manufacturer's fiscal quarter, zero otherwise.

$JustMissQEnd_{t-52}$ equals the value of *JustMissQEnd* one year prior to the observation.

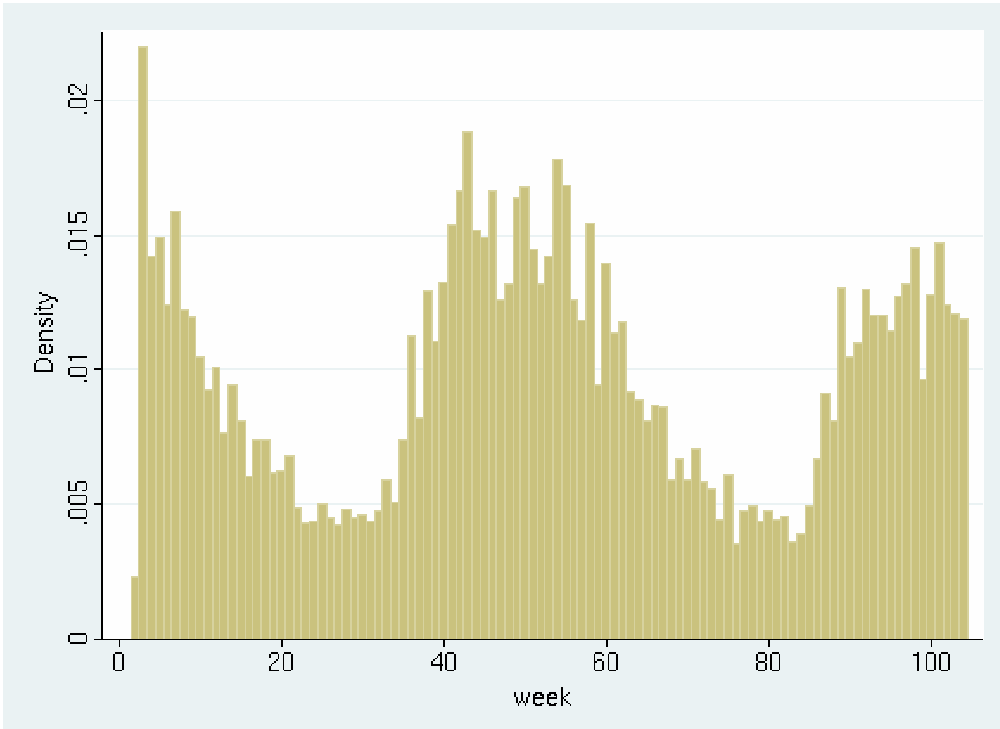
MaxPrice is the maximum price at which the product is sold in the store over the sample period.

$Price_t$ is the average price of the product being sold in week *t*.

$Price_{t-52}$ equals the value of $Price_t$ one year prior to the observation.

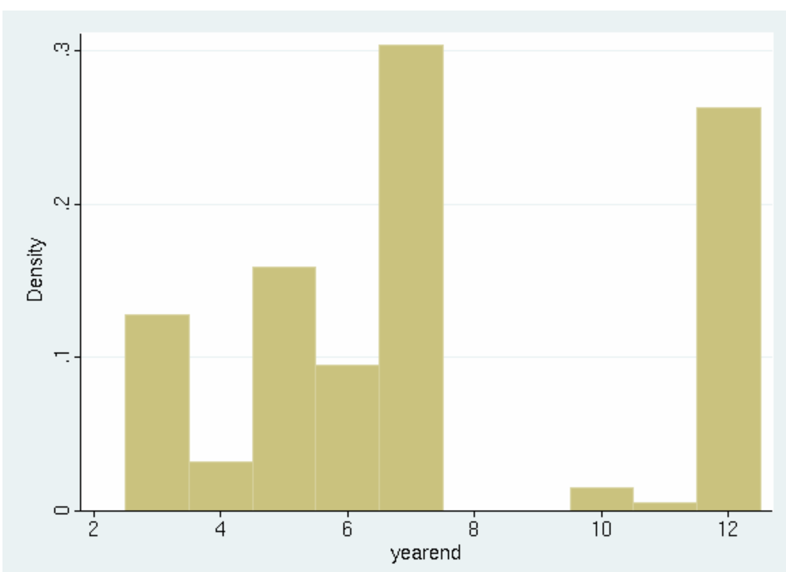
Weekly Units Sold is defined as the number of units of a particular UPC sold in a week.

Figure 1: Sales Frequency by Week



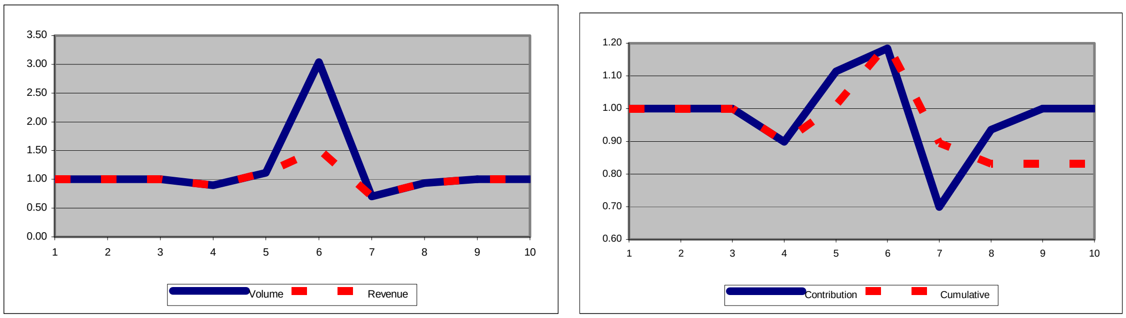
Week one is the beginning of the calendar year.

Figure 2: Fiscal Year-End Frequency Distribution for Companies in Sample (by UPC)



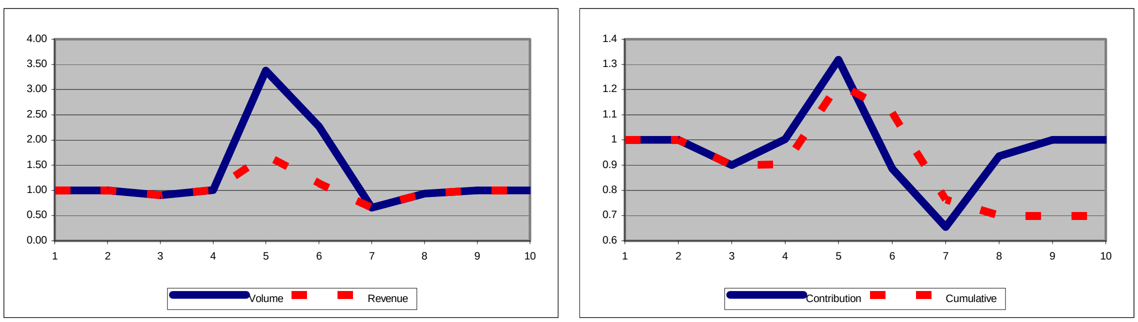
January is Month 1

Figure 3: The Effect on Sales Volumes, Revenues and Contribution of a One Week 50%-Off Price Promotion in Period 6.



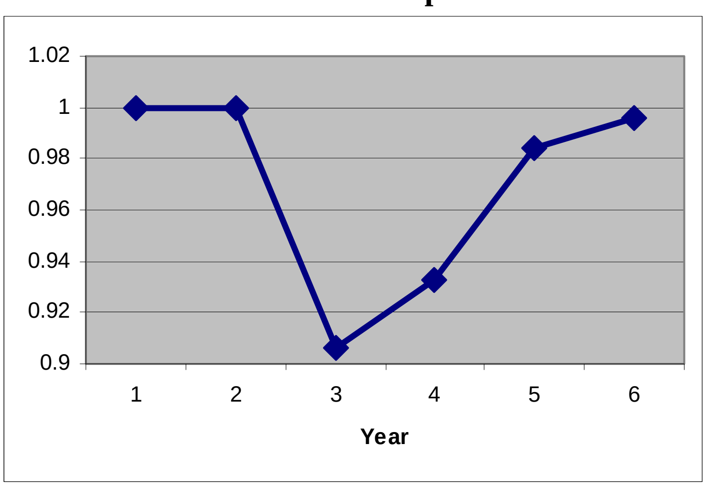
Regular Volume, Revenue and Contribution scaled to One.

Figure 4: The Effect on Sales Volumes, Revenues and Contribution of a Two-Week 50%-Off Promotion in Periods 5 & 6



Regular Volume, Revenue and Contribution scaled to One.

Figure 5: The Effect on Year-end Prices of an Earnings Management Incentive in Year 3 based upon Table 3a



Regular Price scaled to One.

Table 1 - Summary Statistics

Description of Data Availability	Full Sample		Unique UPC Week Observations		Used in Table
Individual Transactions in Database	3,692,858				
Soup Purchases Contained in Database	55,451	100.0%	23,468	100.0%	
Manufacturer is Known	53,637	96.7%	22,343	95.2%	
Fiscal Year-end is Known	52,138	94.0%	21,401	91.2%	
EPS Data	42,434	76.5%	16,895	72.0%	
Analyst Forecasts	41,726	75.2%	11,289	48.1%	
1-week pre- & post- prices			8,302	35.4%	2
2- week pre- & post- prices			4,807	20.5%	2
Prior Year Prices and EPS Change			4,435	[62] 18.9%	3a
Prior Year Prices and Analyst Forecasts			2,543	[63] 10.8%	3b

Variable	Number of Obs.	Mean	Standard Deviation	Used in Table
Ln(Weekly Units Sold)	23,230	0.81	0.853	2
Used in Table 2	8,302	1.19	0.944	2
Price	23,230	1.81	0.892	
Used in Table 2	8,302	1.59	0.756	2
Ln($Price_t$/MaxPrice-$Price_t$)	21,062	1.31	1.220	
Used in Table 2	8,302	1.20	0.969	2
JustBeat EPS Target[64]	16,900	0.11	0.312	3a
JustMiss EPS Target	16,900	0.10	0.303	3a
IncentivesofOthers (EPS Target)[65]	2,969	0.26	0.174	3a
JustBeat Analyst Consensus Earnings F/Cast	10,851	0.17	0.377	3b
JustMiss Analyst Consensus Earnings F/Cast	10,851	0.09	0.284	3b
IncentivesofOthers (Analyst Consensus)[66]	3,639	0.22	0.185	3b
InventoryChange	18,118	-0.02	0.108	3a-3b
UnexpectedInventory	9,016	0.00	0.008	3a-3b

There is no material difference between the sub-samples presented above and those used due to data availability restrictions.

[62] Represents 37.6% of unique UPC Week observations during 2006.
[63] Represents 21.5% of unique UPC Week observations during 2006.
[64] Approximately ⅓ of these observations fall into the last month of the fiscal quarter.
[65] When Non-Zero
[66] When Non-Zero

Table 2 – Impact of Marketing Actions on the Timing of Consumers' Purchases

Dependent Variable	Predicted Sign	*Ln(Weekly Units Sold)*				
		OLS	OLS	OLS	OLS	OLS
Column #		1	2	3	4	5
Ln(Price$_{t-2}$/(MaxPrice- Price$_{t-2}$)) β_{-2}	+			0.042	0.045	0.044
				(2.18)*	(2.17)*	(2.09)*
Ln(Price$_{t-1}$/(MaxPrice- Price$_{t-1}$)) β_{-1}	+	0.058	0.060	0.036	0.040	0.064
		(3.01)**	(3.11)**	(2.02)*	(2.15)*	(2.59)**
Ln(Price$_{t}$/(MaxPrice- Price$_{t}$)) β_{0}	-	-0.293	-0.285	-0.319	-0.317	-0.340
		(-7.81)**	(-7.69)**	(-6.31)**	(-6.22)**	(-5.46)**
Ln(Price$_{t+1}$/(MaxPrice- Price$_{t+1}$)) β_{1}	+	-0.021	-0.018	-0.039	-0.037	-0.035
		(-1.40)	(-1.20)	(-1.94)$^{+}$	(-1.79)$^{+}$	(-1.68)$^{+}$
Ln(Price$_{t+2}$/(MaxPrice- Price$_{t+2}$)) β_{2}	+			0.013	0.015	0.013
				(0.75)	(0.84)	(0.74)
*Indicator*Ln(Price$_{t}$/(MaxPrice-Price))* β_{3}	-					-0.337
Note: The Indicator is a dummy variable equal to one if $Price_{i,t-1} < Price_{i,t}$ *and zero otherwise.*						(-1.87)$^{+}$
Constant		1.498	1.511	1.699	1.675	1.639
		(16.85)**	(17.14)**	(13.32)**	(12.52)**	(13.02)**
N		8,302	8,302	4,807	4,807	4,807
R^2		0.084	0.094	0.089	0.098	0.100
Fixed Effects for Calendar Months		No	Yes	No	Yes	Yes

$^{+}$ Significant at the 10% level (two tail)
* Significant at the 5% level (two tail)
** Significant at the 1% level (two tail)

Note: Models are estimated using Huber-White[67] standard errors to allow for any lack of independence between observations for the same UPC within the sample. Use of standard errors corrected for autocorrelation using the Newey-West procedure for selected regressions does not materially change the conclusions of the paper.[68]

[67] See Huber (1967), White (1980) and Froot (1989).

[68] Consistent with Stock and Watson (Eqn 13.17), I use a 4 period truncation parameter when using the Newey-West procedure being estimated as $\frac{3}{4}n^{1/3}$ where n equals 104, the number of weeks in the sample. Use of alternative truncation parameters does not change the results materially.

Table 3a – The Relation of Price and Just Beating Prior Year Quarterly EPS

Dependent Variable		*Ln(Price$_t$/(MaxPrice-Price$_t$))*			
	Predicted Sign	OLS	OLS	OLS	OLS
Column #		1	2	3	4
JustBeatQEnd$_t$ β_1	-	-0.429	-0.446	-0.416	-0.470
		(-2.11)*	(-2.20)*	(-2.03)*	(-1.85)+
JustMissQEnd$_t$ β_2	?	-0.073	-0.152	-0.153	-0.009
		(-1.00)	(-1.99)*	(-2.03)*	(-0.09)
IncentivesofOthers$_t$ β_3	-		-2.472	-2.475	-1.762
			(-3.23)**	(-3.23)**	(-1.76)+
Ln(Price$_{t-52}$/(MaxPrice-Price$_{t-52}$)) β_4	?	0.264	0.249	0.242	0.206
		(7.73)**	(7.40)**	(7.14)**	(4.70)**
JustBeatQEnd$_{t-52}$ β_5	-	-0.141	-0.221	-0.279	-0.154
		(-2.41)*	(-3.57)**	(-4.17)**	(-1.85)+
JustMissQEnd$_{t-52}$ β_6	?	0.129	0.056	0.070	0.161
		(0.92)	(0.40)	(0.49)	(0.77)
IncentivesofOthers$_{t-52}$ β_7	-		-1.052	-1.016	-0.917
			(-7.76)**	(-7.36)**	(-5.58)**
InventoryChange$_t$ β_8	-			0.935	
				(2.42)*	
UnexpectedInventory (Lag 1 Period) β_9	-				-4.898
					(-1.58)
Constant		1.119	1.212	1.236	1.254
		(22.50)**	(22.95)**	(22.48)**	(16.86)**
N		4,435	4,435	4,435	2,403
R^2		0.040	0.057	0.070	0.044

+ Significant at the 10% level (two tail)
* Significant at the 5% level (two tail)
** Significant at the 1% level (two tail)

Note: Models are estimated using Huber-White Standard errors to allow for any lack of independence between observations for the same UPC within the sample. Use of standard errors corrected for autocorrelation using the Newey-West procedure for selected regressions does not materially change the conclusions of the paper.

Table 3b – The Relation of Price and Just Beating Consensus Forecasts

Dependent Variable		*Ln(Price$_t$/(MaxPrice-Price$_t$))*			
		OLS	OLS	OLS	OLS
	Column #	1	2	3	4
JustBeatQEnd$_t$ β_1	-	-0.298	-0.427	-0.396	-0.168
		(-2.77)**	(-3.75)**	(-3.44)**	(-1.07)
JustMissQEnd$_t$ β_2	+	0.655	0.640	0.663	0.724
		(4.59)**	(3.98)**	(3.98)**	(3.38)**
IncentivesofOthers$_t$ β_3	-		-0.697	-0.693	-0.893
			(-3.19)**	(-3.17)**	(-4.31)**
Ln(Price$_{t-52}$/(MaxPrice-Price$_{t-52}$)) β_4	?	0.188	0.167	0.167	0.116
		(4.70)**	(4.33)**	(4.30)**	(2.59)**
JustBeatQEnd$_{t-52}$ β_5	-	0.023	-0.102	-0.133	-0.18
		(0.40)	(-1.65)+	(-1.94)+	(-0.24)
JustMissQEnd$_{t-52}$ β_6	?	-0.018	-0.024	-0.016	0.05
		(-0.10)	(-0.14)	(-0.09)	(0.19)
IncentivesofOthers$_{t-52}$ β_7	-		-1.393	-1.347	-1.132
			(-9.39)**	(-9.18)**	(-6.09)**
InventoryChange$_t$ β_8	-			0.588	
				(1.33)	
UnexpectedInventory (Lag 1 Period) β_9	-				-6.157
					(-1.71)+
Constant		1.163	1.315	1.315	1.380
		(19.69)**	(20.34)**	(20.27)**	(15.87)**
N		3,130	2,543	2,543	1,385
R^2		0.031	0.062	0.063	0.051

+ Significant at the 10% level (two tail)
* Significant at the 5% level (two tail)
** Significant at the 1% level (two tail)

Note: Models are estimated using Huber-White Standard errors to allow for any lack of independence between observations for the same UPC within the sample. Use of standard errors corrected for autocorrelation using the Newey-West procedure for selected regressions does not materially change the conclusions of the paper.