Modeling brand advertising with heterogeneous consumer response; channel implications

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Abstract
We explore the implications of heterogeneous consumer response to advertising for distribution channel firms. We solve a game theoretic model using a consumer-based utility model for a decentralized and a coordinated channel. We show that heterogeneity considerably affects the value of channel coordination.

Keywords: channel coordination, advertising, game theory.

Introduction
Advertising spending represents a significant portion of firms marketing budgets; it amounts to an estimated $130 billion in the United States (Kantar media report 2010). An extensive literature in marketing has shown the importance of advertising for building brand awareness, encouraging product trial and reinforcing brand equity by improving the product's perceived quality and building preference for the brand (Ackerberg 2001, 2003, Becker and Murphy 1993, Simon and Sullivan 1993, Yoo et al. 2000, Johnson and Myatt 2006).

Brand advertising also significantly affects distribution channels. Manufacturers can benefit from advertising by building stronger brands, thereby gaining market share and negotiating better deals with their channel partners. This in turn affects indirectly retailers' operations, assortments and agreements with suppliers. Since advertising affects consumer demand, it can also have a direct impact on retailers' revenues.

While there is a large literature about pricing decisions in channels, the implications of brand advertising as a strategic tool for manufacturers and retailers remain relatively unexplored. Most research in this area has been about the role of persuasive advertising for competing firms fighting for market share (Kaul and Wittinik 1995, Shaffer and Zettelmeyer 2004, Wang et al. 2011) or about local advertising activities undertaken by the retailer for the manufacturer's brands (Kim and Staelin 1999, Karray and Zaccour 2006, 2007). Few papers have also looked at the strategic implication of brand advertising for distribution channels providing competing national brands and private labels (e.g., Jørgensen and Zaccour 1999, Karray and Zaccour 2006, Karray and Martin-Herran 2008, 2009). This literature has modeled demand from the firms' perspective and assumed homogeneous consumer response to advertising efforts.

This assumption can be restrictive given the empirical evidence showing heterogeneity in consumer response to marketing efforts (Albuquerque and Bronnenberg 2009, Chintagunta 2001). As defined by Allenby et al. (1998); "demand heterogeneity traditionally has been defined as segments of consumers that are homogeneous with regard to the benefits they seek or in their response to marketing programs". Segmentation based on consumer responses to marketing mix can be more effective than traditional segmentation techniques that use consumer personal characteristics (Brusco et al. 2002, Green and Krieger 1991, Gupta and Chintagunta 1994).

Research shows that different factors can explain a heterogeneous response to advertising. These include consumer personal characteristics, media preferences, and their involvement with the product category (Vakratsas and Ambler 1999). For example, Putrevu and Lord (1994) found that non-comparative ads are more effective amongst consumers who are loyal to an existing brand due to their affective involvement towards the product. Manchanda et al. (2006) also showed evidence of considerable heterogeneity across consumers in their response to banner advertising.

This research provides insights about the role of brand advertising in a distribution channel when we account for demand heterogeneity in consumer response to ads. In particular, we look at how pricing and advertising strategies should be adjusted to changes in consumer response to advertising for a coordinated and uncoordinated (decentralized) channel. Then, we evaluate the effects of coordination on the channel's strategies and performance and discuss the influence of consumer demand heterogeneity on such effects. A large marketing and operations management literature has shown the importance of coordinating decisions in the channel to improve its overall performance (Ingene and Parry 1995, Jeuland and Shugan 1983, Manchanda et al. 2006). We aim to contribute to this literature by looking at channel coordination benefits given consumer heterogeneous response to brand advertising.

We study these issues by developing a game theoretic model that accounts for heterogeneous responses to advertising in consumers' utility, thereby demand. We solve and compare results from sequential games in pricing and advertising for the uncoordinated and the coordinated channel.

The rest of the paper is organized as follows: Section 2 explains the game theoretic model; Section 3 describes the analysis of the channel's strategies and performance, and the effects of channel coordination. Finally, Section 4 provides conclusions and suggests further research.

Model

We consider a channel where a manufacturer is selling through a retail store to end consumers. Each buyer gets one unit of the product as long as his/her utility surplus is positive. Consumers have a common reservation value (v), which represents consumers' willingness to pay for the manufacturer's product independently of the effects of advertising or travel costs.

Advertising by the manufacturer improves brand image through the beneficial associations created for the product and provides consumers with additional utility. Consumers' heterogeneity with respect to advertising response is modeled by considering two segments of consumers (H and L). Segment H represents the consumers who highly value brand advertising for the product. Let (α) be the size of this segment ($\alpha \in (0, 1)$). The remaining consumers are less sensitive to advertising activities for the brand. They form the low response segment (Segment L), which is of size ($1- \alpha$).

To represent heterogeneous response to advertising in the consumers' utility function, we consider that consumers in each segment have different degrees of willingness to pay for brand advertising. Let (s_H) and (s_L) be the willingness to pay for an additional unit of advertising effort (a) in the H segment and the L segment respectively ($s_H > s_L$).

Consumers in each segment are horizontally and uniformly distributed on a unit line as per the Hotelling model (Hotelling 1929). Each consumer incurs a mismatch (or disutility) cost when he/she deviates from his/her ideal product located at point zero. A consumer belonging to the segment $I \in (L, H)$ has a positive per-unit cost of (t), which represents the consumer per unit cost of travelling to the retail store, or more generally the mismatch (disutility) cost when he/she deviates from his/her ideal location. A consumer who belongs to segment $I \in (L, H)$ and is located at distance $x \in (0, 1)$ from his/her ideal point, pays a price (p) for the product and derives a utility of $U_I(a, p, x)$ given by $U_I = v + s_I a - p - tx$.

Finally, the no-purchase option gives the consumer zero utility. Each consumer in segment $I \in (L, H)$ is indifferent between buying the product and buying nothing (the only two alternatives available) if and only if ($U_I = 0$), which can be written as:

$$x_I = \frac{v + s_I a - p}{t}. \quad (1)$$

The location of the consumer type I (x_I) represents the penetration rate of the product in segment I. The total demand (D) is then obtained by multiplying each segment's penetration rate by its size, which gives $D = \alpha x_H + (1 - \alpha) x_L$.

In order to study the effects of coordination on strategic outputs, we obtain results from two scenarios; a decentralized channel, as well as a coordinated one.

In the decentralized channel, decisions are made independently by each firm. We assume that the manufacturer incurs a null marginal production cost for simplicity and without loss of generality. The manufacturer charges the retailer a transfer price (w) for each unit sold and pays an advertising cost of ($a^2/2$) for promoting a product with a level of effort (a). This cost function has been widely used in the literature and implies an increasing marginal cost of advertising (e.g., Chu and Desai 1995, Jørgensen et al. 2001).

The manufacturer's profit function (Π_M) is given by its revenues from selling the product, diminished by advertising costs. The retailer's profits (Π_R) are generated by its revenues from selling the product to consumers.

Note that an alternative approach for modeling advertising effects on profits would be to assume decreasing marginal returns of advertising in demand and linear cost functions. For example, considering square-rooted advertising in the demand function and a linear cost function (Kim and Staelin 1999, Karray and Zaccour 2006) would yield more complicated equilibrium expressions but the same qualitative results to the ones obtained this paper. The profit functions are given by $\Pi_M = wD - a^2/2$ and $\Pi_R = (p - w)D$.

In the decentralized channel, the equilibrium pricing and advertising strategies are determined as follows. First, the manufacturer sets the advertising level. Then, given this decision, it determines the wholesale price. Finally, the retailer chooses the consumer price knowing both the manufacturer's price and the advertising level. This sequence of play is based on evidence that a manufacturer Stackelberg game is often appropriate for pricing behaviors in channels (Sudhir 2001). Also, advertising and pricing should be decided at different stages of the game, mainly because once undertaken, advertising generally becomes a sunken investment for organizations.

Finally, in the coordinated channel, all decisions are centralized at one level of the channel. In this case, the advertising decision is made in a first step and the consumer price is decided later on. The total channel profit is maximized and is given by $\Pi = pD - (a^2/2)$.

Analysis of equilibrium strategies

Equilibrium advertising, prices and profits are obtained by solving the game backwards for the decentralized and coordinated channels. In the rest of the paper, equilibrium for the decentralized channel is noted with the superscript (*d*) and those for the coordinated channel with (*c*).

We start by discussing the equilibrium advertising, pricing and outputs for the decentralized channel, followed by the coordinated case. Finally, we compare results in order to evaluate the effects of coordination on strategic outputs at equilibrium, given the heterogeneity of consumer response to advertising.

The decentralized channel

Equilibrium advertising, prices and profits are obtained by solving the three-stage game backwards. We start by solving the retailer's pricing problem and maximize the retailer's profits with respect to the retail price (*p*) by solving the first-order condition ($\frac{\partial \Pi_R}{\partial p} = 0$) in (*p*). We obtain the price reaction to advertising and to the wholesale price given by;

$$p = \tfrac{1}{2}\left[v + w + a\left(s_L + \alpha s_H - \alpha s_L\right)\right], \tag{2}$$

Then, we substitute (*p*) by (2) into the manufacturer's profit function and maximize the obtained expression with regards to the wholesale price (*w*). Solving the first-order condition ($\frac{\partial \Pi_M}{\partial w} = 0$) in (*w*), we get;

$$w = \frac{1}{2}\left[v + a\left(s_L + \alpha s_H - \alpha s_L\right)\right]. \tag{3}$$

Finally, substitute (*w*) back in the manufacturer's profits and solve its first-order condition ($\frac{\partial \Pi_M}{\partial a} = 0$) in (*a*) to obtain the equilibrium advertising for the game denoted by (a^d). The equilibrium wholesale price (w^d) is then obtained by substituting advertising by (a^d) in equation (3). The equilibrium retail price is found by substituting (*w*) by (w^d) and (*a*) by (a^d) back in (2). We finally replace the equilibrium in the profit functions and in x_I ($I = L, H$) to obtain equilibrium profits and demands.

Proposition 1: In the decentralized channel, for any $t > \delta^2/4$, the equilibrium solution is

$$a^d = v\delta/(4t-\delta^2), p = 3tv/(4t-\delta^2), w^d = 2tv/(4t-\delta^2),$$
$$x_L^d = v[t-\delta\alpha(s_H - s_L)]/t(4t-\delta^2), x_H^d = v[t+\delta(1-\alpha)(s_H - s_L)]/t(4t-\delta^2),$$
$$D^d = v/(4t-\delta^2),$$
$$\Pi_R^d = tv^2/(4t-\delta^2)^2, \Pi_M^d = v^2/2(4t-\delta^2), \Pi^d = v^2(6t-\delta^2)/2(4t-\delta^2)^2.$$

With $\delta = s_L + \alpha s_H - \alpha s_L$.

Proof: Equilibrium solution is obtained using the backward induction method described in this section. We can easily verify that interior solutions are obtained for $t > \delta^2/4$.■

Given the reaction functions in (2) and (3), we can see that, in the decentralized channel, both of the manufacturer and the retailer prices are positively related to brand advertising.

Therefore, consumers would pay increased prices when the product image is reinforced by the manufacturer's advertising campaigns. This result is consistent with empirical evidence about the effect of non-price advertising on prices (Kaul and Wittinik 1995).

Further, we can easily see from (2) and (3), that ($p - w = w/2$). Therefore, the manufacturer earns a unit margin that is twice as high as that of the retailer, which is due to double marginalization given the decentralized structure of the channel. This in turn explains why the manufacturer's price reaction to increased brand advertising is smaller than the retailer's reaction.

Proposition 2: In the decentralized channel, assuming interior equilibrium solutions and for any for any $z \in \{ s_H, s_L, \alpha \}$;

$$
\begin{aligned}
&a.\ (\partial a^d / \partial z), (\partial p^d / \partial z), (\partial w^d / \partial z) > 0, \\
&\quad (\partial D^d / \partial z), (\partial \Pi_R^d / \partial z), (\partial \Pi_M^d / \partial z), (\partial \Pi^d / \partial z) > 0. \\
&b.\ (\partial a^d / \partial s_H) > (\partial a^d / \partial s_L) \Leftrightarrow \alpha > 1/2, \\
&\quad (\partial p^d / \partial s_H) > (\partial p^d / \partial s_L) \Leftrightarrow \alpha > 1/2.
\end{aligned}
$$

Proof: Results in (a) are obtained by computing the derivatives of equilibrium strategies and outputs with regards to the parameters (s_L, s_H and α). The second part of the Proposition (b) is obtained by computing $(\partial a^d / \partial s_H) - (\partial a^d / \partial s_L)$ and $(\partial p^d / \partial s_H) - (\partial p^d / \partial s_L)$.■

The result in (a) shows that equilibrium advertising, pricing, demand and each member's profit, react positively to increases in consumer response to advertising (s_L and s_H) and to the size of the H segment (α). Intuitively, we find that the manufacturer should boost advertising as consumers become more sensitive to ads whether these consumers pertain to the most or to the least responsive group.

Further, the finding in (b) shows that the manufacturer's advertising reaction should be stronger following a change in a given consumer segment's response to ads only if this segment is also largest in size. This means that, when most consumers in the market are not highly sensitive to advertising ($\alpha < 1/2$), a marginal increase in their response level (sL), through the use of say more effective media or new creative contents, would lead to higher incremental advertising efforts than a marginal increase in the level of the H segment's response.

Similar results are found for prices, which also increase with higher ad response levels in both segments. Prices should be more sensitive to changes in consumers' response to ads only when they pertain to the largest segment. This is mainly due to the fact that prices are positively related to advertising, which in turn increases with (s_L) and (s_H).

These findings show that the size of consumer segments (the value of α) considerably affects the amplitude of equilibrium strategies' reaction to changes in (s_L) and (s_H). Such analysis is of interest when comparing strategies undertaken by manufacturers operating in markets with different consumer characteristics; or when evaluating the effects of change in consumers' response levels in a given market.

Finally, results show that total demand (from both segments) also reacts positively to changes in ad sensitivity levels and to the highly sensitive segment's size. Since more consumers will get positive utility from the product, this in turn boosts demand and leads to both higher revenues and higher profits for both the manufacturer and the retailer. Therefore, in a decentralized channel, both the manufacturer and the retailer can reap additional profits when the highly sensitive consumer size is larger or when consumer sensitivity in either segment is increased.

The coordinated channel

For the coordinated channel, the problem is to maximize total channel profits (Π) with respect to consumer price and advertising such as $\max_{a,p} \Pi = pD - (a^2/2)$.

The equilibrium advertising and price are obtained by solving the two-stage game backwards. We start by solving the pricing problem and maximize the total channel profits (Π) with respect to the retail price (p) by solving the first-order condition ($\frac{\partial \Pi}{\partial p} = 0$) in ($p$). We obtain the following price reaction to advertising;

$$p = (v + a\delta)/2. \tag{4}$$

Notice that the consumer price reaction to advertising shows that price is less sensitive to changes in advertising when the channel is coordinated compared to the decentralized case (see equation (2)). This result highlights the importance of coordination for channels that are investing in brand advertising. It also demonstrates that while ad spending would increase prices, the elimination of double margins prohibits excessive charges; which can be beneficial to consumers who consequently get higher utility and to firms who get higher demand for the product.

In a second stage, we substitute (p) back in the channel's profits and solve the first-order condition ($\frac{\partial \Pi}{\partial a} = 0$) in ($a$) to obtain the equilibrium advertising for the coordinated game. The equilibrium price is found by substituting (a) by (a^c) back in (4). We finally replace the equilibrium in the profit functions and in (x_I) to obtain equilibrium profits and demand.

Proposition 3: In the coordinated channel, for $t > \delta^2/2$, the equilibrium solution is

$$a^c = v\delta/(2t - \delta^2), p^c = tv/(2t - \delta^2),$$
$$D^c = v/(2t - \delta^2), \Pi^c = v^2/2(2t - \delta^2),$$
$$x_L^c = v[t - \delta\alpha(s_H - s_L)]/t(2t - \delta^2),$$
$$x_H^c = v[t + \delta(1-\alpha)(s_H - s_L)]/t(2t - \delta^2).$$

Proof: Equilibrium solution is obtained using the backward induction method described in this section. We can easily verify that interior solutions are obtained for $t > \delta^2/2$.■

Effects of channel coordination

We now compare findings for the coordinated and the decentralized channel and assess the influence of consumer heterogeneity on the noted differences.

Proposition 4: Assuming interior equilibrium solutions for both the decentralized and the coordinated channels (i.e., for $t > \delta^2/2$), and $\forall z \in \{s_H, s_L, \alpha\}$;

$$\frac{\partial a^c}{\partial z} > \frac{\partial a^d}{\partial z}, \frac{\partial p^c}{\partial z} > \frac{\partial p^d}{\partial z}, \quad \frac{\partial D^c}{\partial z} > \frac{\partial D^d}{\partial z}, \frac{\partial \Pi^c}{\partial z} > \frac{\partial \Pi^d}{\partial z}.$$

This proposition shows that the equilibrium strategies for a coordinated channel react qualitatively in the same way to changes in the model's parameters as the equilibrium of the decentralized channel. However, the reactions of equilibrium strategies are quantitatively different under the coordinated channel. In particular, demand and profits are more responsive to changes in all of the parameters (s_L, s_H and α) when the channel is coordinated.

This result has two implications. First, a decentralized channel's prices and advertising levels are more rigid to changes in market conditions. For example, increased consumer ad sensitivity would be more effective in boosting demand and profits for a coordinated rather than an uncoordinated channel. Second, it means that information about demand heterogeneity, i.e., accurate estimation of (s_L, s_H and α), can be more valuable for a coordinated channel than for a decentralized one. Next, we compare strategies and outputs obtained from the decentralized and coordinated channels.

Proposition 5: Assuming interior equilibrium solutions for both the decentralized and the coordinated channels (i.e., for $t > \delta^2/2$);

$$a^c > a^d, x_I^c > x_I^d, \Pi^c > \Pi^d, p^c > p^d \Leftrightarrow t < \delta^2.$$

Proof: Comparison of equilibrium pricing strategies obtained from the coordinated and the uncoordinated channels gives; $p^c - p^d = -2tv(t-\delta^2)/[(2t-\delta^2)(4t-\delta^2)]$. Given interior equilibrium solutions ($t > \delta^2/2$), we get $p^c > p^d \Leftrightarrow t < \delta^2$. All remaining results are obtained by calculating the differences between equilibrium solutions obtained in the coordinated and decentralized scenarios given by the expressions; $a^c - a^d$, $x_I^c - x_I^d$ and $\Pi^c - \Pi^d$. ■

Proposition 5 shows that advertising expenditures, per segment penetration rate and total profit are higher for the coordinated channel than they are for the decentralized channel. However, coordination would lead to increased prices when the consumer transportation cost is too low.

This result supports the evidence that coordination increases advertising levels and improves channel performance (Ingene and Parry 1995, Jeuland and Shugan 1983, Manchanda et al. 2006). However, it provides new insights about the effect of coordination on consumer price. While channel coordination is traditionally found to decrease prices thanks to double marginalization based savings, we show that it can be optimal to charge higher prices in the coordinated channel.

The increase in price is mainly due to the role of advertising in boosting consumer utility. The coordinated channel can use part of the savings from double margins to increase ad spending. The latter creates added consumer utility, which makes it beneficial for the channel to increase prices as well. This happens when consumers' inertia is low compared to the average unit benefit from advertising across market segments. In this case, consumer utility would not suffer significantly from higher prices and enough consumers would be willing to pay the mismatch cost in order to purchase the product. This ultimately results in higher penetration rates in each segment, leading to more demand and profits for the coordinated channel.

Effect of consumer heterogeneity on the impact of channel coordination

In order to understand the influence of consumer heterogeneity on previously obtained results, we evaluate the sensitivity to consumer advertising response for the expressions; $\Delta a = a^c - a^d$, $\Delta p = p^c - p^d$, $\Delta x_I = x_I^c - x_I^d$ and $\Delta\Pi = \Pi^c - \Pi^d$. We perform this analysis and compare results for the following scenarios;

1. Heterogeneity ($s_L \neq s_H$); In this case, firms consider the weighted average of consumer ad sensitivity $(\delta = s_L + \alpha s_H - \alpha s_L)$ to determine equilibrium strategies. Channel

coordination effects for strategies and profits are consequently dependent on values of δ.

2. Homogeneity ($s_L = s_H$); channel members overlook the heterogeneity of consumers' response to advertising and can use one of the following scenarios;

2.1. Pessimistic case (s_L): the estimation of consumer sensitivity to advertising is "pessimistic" because consumers' responses in the entire market are under-evaluated.

2.2. Optimistic case (s_H). This is the "optimistic" scenario since consumers' ad sensitivity for the entire market is over-valued.

Given that $\partial\delta / \partial s_H = \alpha > 0$ and $\partial\delta / \partial s_L = (1-\alpha) > 0$, the derivatives of the expressions $\Delta p, \Delta a, \Delta x_I, \Delta\Pi$ to changes in δ have the same sign than their derivatives with regards to the response parameters s_H and s_L. Sensitivity analysis for the above scenarios can therefore be obtained by computing the derivatives of expressions $\Delta p, \Delta a, \Delta x_I, \Delta\Pi$ with regards to δ, which leads to the following proposition.

Proposition 6: Assuming interior equilibrium solutions;

$$\partial\Delta p / \partial\delta > 0, \ \partial\Delta a / \partial\delta > 0, \ \partial\Delta x_I / \partial\delta > 0, \ \partial\Delta\Pi / \partial\delta > 0,$$

Proof: Straightforward using the interior equilibrium condition of $t > \delta^2/2$.■

Proposition 6 shows that channel coordination effects are heightened when the consumer sensitivity to advertising increases. The first implication of this result is that channel members would reap additional benefits from coordinating their pricing decisions in markets characterized by high sensitivity to brand advertising. This shows the importance of modeling advertising decisions in a distribution channel framework given the interplay with pricing strategies.

In case of a pessimistic estimation of the consumer ad sensitivity, the outcome would be to underestimate the benefits of channel coordination in terms of the additional demand and profits that could be obtained, and would lead to sub-optimal increase in spending for brand advertising and inaccurate adjustment of pricing in the coordinated channel.

In the optimistic case, the benefits from coordination would be inaccurately exaggerated. An excessive adjustment in price (in absolute value) and advertising levels also follows, which could be detrimental to the channel's profitability.

Intuitive implications of these results are showcased next through numerical examples. The numerical values are chosen to comply with interior equilibrium solutions in the coordinated and decentralized channels and to represent different segment size as well as ad sensitivity scenarios. The numerical examples are obtained assuming $v = 10$. Note that the value of v does not affect the results qualitatively since it serves mainly as a scale factor in the expressions of Δa, Δp and $\Delta\Pi$.

Figure 1 shows several examples of market conditions for which major discrepancies exist in the effect of coordination on pricing, advertising and profits. These discrepancies depend on whether or not consumer heterogeneity is considered.

As we can see in case 1, a pessimistic estimation of consumer ad sensitivity mistakenly leads to lowering of prices in the coordinated channel. However, in the optimistic scenario, the effect of coordination on price would be exaggerated through an excessive price increase. Similarly, changes in advertising spending and profits due to channel coordination could be underestimated in the pessimistic scenario and would mistakenly lead to inflated pricing in the optimistic case.

Alternatively, as we can see in case 2, ignoring consumers' heterogeneous ad response leads to an excessive drop in price in the pessimistic scenario and in unnecessary price increase in the optimistic one. The discrepancies in the estimated effect of coordination on ad spending and profits are also noticeable in the other numerical examples for cases 3 and 4.

These examples support the analytical result in Proposition 6 and provide a better understanding of the strategic implications of heterogeneous responses to brand advertising.

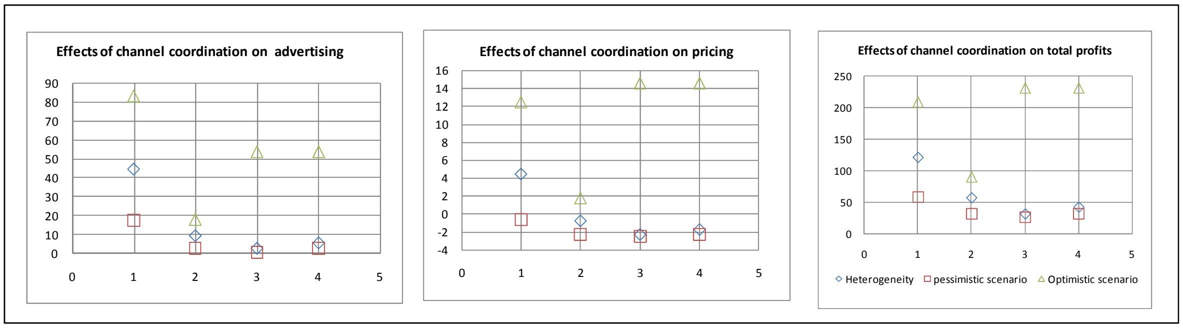

Figure 1: Examples of Heterogeneity effects on strategies and profits

Conclusions

We study the effect of consumers' heterogeneous response to brand advertising on the value of channel coordination. We develop a game theoretic model based on consumer utility, and solve for equilibrium pricing and advertising strategies that maximize the firms' profits.

The key findings show the importance of accounting for the heterogeneity of consumers' responses to advertising when assessing the implications of channel coordination. While variations in consumer response to ads lead to increased pricing and advertising strategies, the magnitude of this increase depends on which segment the consumer belongs to and on the size of that segment. In particular, the firms' strategies will be more reactive to the high valuation consumers' response than to the low-valuation one, only if these consumers also represent the largest portion of the market.

While coordination has been known to decrease prices, results from our utility-based model show that it can also lead to higher prices. This happens when consumers' cost of deviating from their ideal product is lower than the average benefit from advertising across market segments. Also, the gains from coordination could be over or under-estimated and the resulting adjustments in prices and advertising strategies could be harmful to the firms' profitability. These findings are important for channel managers concerned about choosing the right advertising and pricing levels that would both maximize their profits and provide maximum utility to consumers.

Finally, future work can consider extending our analysis to include competition at each level of the channel or dynamic temporal effects of advertising, although such analysis would significantly complicate results. Additional research could also examine other marketing mix variables, such as promotions, that could impact consumers' utility and firms' profitability.

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References

Ackerberg, D. 2001. Empirically distinguishing informative and prestige effects of advertising. *RAND Journal of Economics*, **32**: 100–118.

Ackerberg, D. 2003. Advertising, learning, and consumer choice in experience good markets: A structural empirical examination. *International Economic Review*, **44**: 1007–1040.

Albuquerque, P., Bronnenberg, B. J. 2009. Estimating demand heterogeneity using aggregated data: An application to the frozen pizza category. *Marketing Science*, **28** (2): 356–372.

Allenby, G. M., Arora, N., Ginter, J. L. 1998. On the heterogeneity of demand. *Journal of Marketing Research*, **35**: 384–389.

Becker, G. S., Murphy, K. M. 1993. A simple theory of advertising as a good or bad. *Quarterly Journal of Economics*, **108** (4): 941–964.

Brusco, M. J., Cradit, J. D., Stahl, S. 2002. A simulated annealing heuristic for a bicriterion partitioning problem in market segmentation. *Journal of Marketing Research*, **39** (1): 99–109.

Chintagunta, P. K. 2001. Endogeneity and heterogeneity in a Probit demand model: estimation using aggregate data. *Marketing Science*, **20** (4): 442–457.

Chu, W., Desai, P. S. 1995. Channel coordination mechanisms for customer satisfaction. *Marketing Science*, **14** (4): 343–359.

Green, P. E., Krieger, A. M. 1991. Segmenting markets with conjoint analysis. *Journal of Marketing*, **55** (4): 20–31.

Gupta, S. and Chintagunta, P. K. 1994. On using demographic variables to determine segment membership in Logit mixture models. *Journal of Marketing Research*, **31** (1): 128–36.

Hotelling, H. 1929. Stability in competition. *Economic Journal*, 39: 41–57.

Ingene, C. A., Parry, M. E. 1995. Channel coordination when retailers compete. *Marketing Science*, **14** (4): 360–377.

Jeuland, A. P., Shugan, S. M. 1983. Managing channel profits. *Marketing Science*, **2** (3): 239–272.

Johnson, J. P., Myatt, D. P. 2006. On the simple economics of advertising, marketing, and product design. *American Economic Review*, **96** (3): 756–784.

Jørgensen, S., Zaccour, G. 1999. Equilibrium pricing and advertising strategies in a marketing channel. *Journal of Optimization Theory and Applications*, **102** (1): 111–125.

Jørgensen, S., Taboubi, S., Zaccour, G. 2001. Cooperative advertising in a marketing channel. *Journal of Optimization Theory and Applications*, **110:** 145–158.

Kantar Media online report (2010). http://kantarmediana.com/intelligence/press/kantar-media -reports-us-advertising-expenditures-increased-57-first-half-2010.

Karray, S., Martin-Herran, G. 2008. Investigating the relationship between advertising and pricing in a channel with private label offering: a theoretic model. *Review of Marketing Science*, **6**, Article 1.

Karray, S., Martin-Herran, G. 2009. A Dynamic model for advertising and pricing competition between national and store brands. *European Journal of Operational Research*, **193** (2): 451–467.

Karray, S., Zaccour, G. 2006. Could co-op advertising be a manufacturer's counterstrategy to store brands?. *Journal of Business Research*, **59** (9): 1008–1015.

Karray, S., Zaccour, G. 2007. Effectiveness of coop advertising programs in competitive distribution channels. *International Game Theory Review*, 9 (2): 151–167.

Kim, S.Y., Staelin, R. 1999. Manufacturer allowances and retailer pass-through rates in a competitive environment. *Marketing Science,* **18** (1): 59–76.

Kaul, A., Wittink, D. R. 1995. Empirical generalizations about the impact of advertising on price sensitivity and price. *Marketing Science*, **14** (3): 151–160.

Manchanda, P., Dubé, J. P, Yong Goh, K., Chintagunta, P. K. 2006. The effect of banner advertising on Internet purchasing. *Journal of Marketing Research*, **43** (1): 98–108.

Putrevu, S., Lord, K. R. 1994. Comparative and noncomparative advertising: Attitudinal effects under cognitive and affective involvement conditions. *Journal of Advertising*, **23** (2): 77–91.

Shaffer, G., Zettelmeyer, F. 2004. Advertising in a distribution channel. *Marketing Science*, **23** (4): 619–628.

Simon, C., Sullivan, M. W. 1993. The measurement and determinants of brand equity: A financial approach. *Marketing Science*, **12**: 28–52.

Sudhir, K. 2001. Structural analysis of manufacturer pricing in the presence of a strategic retailer. *Marketing Science*, **20** (3): 244–264.

Vakratsas, D., Ambler, T. 1999. How advertising works: What do we really know. *Journal of Marketing*, **63** (January): 26–43.

Yoo, B., Donthu, N., Lee, S. 2000. An examination of selected marketing mix elements and brand equity. *Journal of the Academy of Marketing Science*, **28** (2): 195–211.

Wang, C. J., Chen, Y. J., Wu, C. C. 2011. Advertising competition and industry channel structure. *Marketing Letters*, **22**: 79–99.