The Effect of Search Channel Elimination on Purchase Incidence, Order Size and Channel Choice

Umut Konuş
Eindhoven University of Technology
School of Industrial Engineering & Innovation Sciences

Scott A. Neslin
Dartmouth College
Tuck School of Business

Peter C. Verhoef
University of Groningen
Faculty of Economics and Business

November, 2011

1 We acknowledge the analytical support of Paul Wolfson. We also acknowledge comment of seminar participants at Tel Aviv University and participants of the special sessions on multi-channel marketing at the Marketing Science Conference in Cologne, and at the EMAC Conference in Copenhagen 2010.

2 Address for Correspondence: Umut Konuş, Eindhoven University of Technology (TU/e), School of Industrial Engineering & Innovation Sciences, Innovation, Technology, Entrepreneurship & Marketing Group, P.O. Box 513, 5600MB, Eindhoven, the Netherlands. Tel: +31 40 2475549; Fax: +31 40 2468054; E-mail: u.konus@tue.nl
The Effect of Search Channel Elimination on Purchase Incidence, Order Size and Channel Choice

Abstract

This study investigates the impact of eliminating a search channel on purchase incidence, order size, channel choice and ultimately sales and profits. We analyze customer panel data from a large retailer over a five-year period. The retailer conducted a randomized field test where the firm eliminated its catalog for half of the panel. We find that channel elimination decreases purchase incidence, especially for customers who before the test were heavy users of the telephone purchase channel that aligns with the catalog search channel. As expected, channel choice for purchase is shifted toward the Internet; from the telephone channel, especially for customers who had been heavy users of the telephone channel. Order size per purchase increases, especially for customers with high initial order sizes. We use simulation to determine the impact of channel elimination on profits. We calculate a net positive impact because the savings from eliminating the catalog compensate for lower sales. The shift from the telephone to the Internet purchase channel is statistically significant but not large enough to contribute much in savings.

Keywords: multichannel, customer relationship management, Internet, catalog shopping, retailing, panel data analysis
INTRODUCTION

In the past years we have observed an increased use of multiple channels by firms and consumers (Neslin et al. 2006; van Bruggen et al. 2010). The movement to multichannel has been more than just Internet adoption. Single-channel catalog companies such as Lands End and LL Bean added the Internet, but also added bricks-and-mortar stores. Insurance companies found themselves marketing not only through agents, but through the Internet as well as call centers. Traditional bricks-and-mortar retail stores ranging from Best Buy to Bloomingdales added the Internet as well as catalogs to the repertoire of channels through which they could interact with customers.

Neslin and Shankar (2009) emphasize that multichannel customer management requires not just the introduction of new channels, but also the elimination of ineffective and costly channels. As customers increasingly use online channels for the various phases of the shopping process (e.g., search, purchase, after-sales support), companies find the idea of eliminating costly channels such as catalogs appealing, even if some customers still use them. For example, the Discovery Channel’s retail arm closed its mall-based and stand-alone stores but increased its e-commerce presence (Dilworth 2007). The European low-fare airline Ryanair announced it would close all its airport check-in desks by October 2010, forcing passengers to use online check-in (McNamara 2009). However, Neslin and Shankar (2009) argue that “right-channeling” i.e., forcing customers to use certain channels, may turn them off because it steers them to use channels that are contrary to their preferences. This may cause negative customer attitudes, including reactance and dissatisfaction (e.g., Reinders, Dabholkar, and Frambach 2008). Several studies investigate the introduction of new channels and the effects on customer metrics and firm performance (e.g., Deleersnyder et al. 2002; Geyskens et al. 2002; Pauwels et al. 2011; van Nierop et al. 2011). However, research on
multichannel customer management has neglected the effects of channel elimination. In this study we aim to address this important gap in the literature.

Specifically, we investigate the behavioral consequences of eliminating a search channel by analyzing a field experiment in which a firm eliminated a search channel for a randomly selected group of customers. The behavior of this group is compared with that of a control group for which the search channel is still present. We investigate five questions: (1) What is the effect of this channel elimination on purchase incidence, average order size and channel choice? (2) Which customer characteristics (i.e. past customer behavior, past channel choice) moderate this effect? (3) Can e-mail communications moderate the effects of channel elimination? (4) How do the effects of channel elimination evolve over time? (5) What is the total impact on sales and profits? By investigating these questions our research is the first to investigate the effect of channel elimination on customer behavior and hence clearly contributes to the literature on multichannel marketing.

To address our five research questions we estimate purchase incidence, channel choice, and order size models (Ansari, Mela, and Neslin 2008). We hypothesize and find that channel elimination decreases purchase incidence, especially for customers who before the experiment were heavy users of the telephone purchase channel that aligns with the catalog search channel. As expected, channel choice for purchase is shifted toward the Internet; away from the telephone channel, especially for customers who had been heavy users of the telephone channel. Contrary to hypothesis, order size per purchase increases, especially for customers with higher pre-experiment order sizes. We use simulation to determine the total impact of channel elimination on sales. This turns out to be negative. However, we calculate a net increase in profits over these 28 months due primarily to savings on catalog mailings.

The catalog retailing industry offers a good context for investigating the consequences of channel elimination, especially during its recent transition to e-tailing. This transition could
induce firms to eliminate the catalog channel (Diakova 2005; Venkatesh 2005). First, printing and mailing costs are costly (Vovici EFM Research 2008). Second, the Internet is replacing telephone call-centers as a purchase channel, and call-center purchases are stimulated by catalogs (Ansari, Mela, and Neslin 2008). Third, mail order sales traditionally generated by catalogs have declined precipitously (Diakova 2005; National Directory of Catalogs 2009). As a consequence companies with a strong and growing Internet presence debate whether it continues to be profitable to mail catalogs to customers who can, and increasingly do, access online information channels (Diakova 2005). Despite this trend, empirical evidence still supports an important role for catalogs. More than 65% of online shoppers used print catalogs to search for information (Jandial, Ogawa, and Sekheran, 2005), and 55% of online consumers shop with a catalog in hand (e-Marketer 2004). Print catalogs also play a dual role as both an impetus (Venkatesh 2005) and a purchase driver for both the online and the store channel (Diakova 2005; Venkatesh 2005; Pauwels and Neslin 2008). So the decision to eliminate the catalog is a plausible although by no means clear-cut decision for firms.

We proceed as follows: First, we review prior research. Next, we present our conceptual framework and hypotheses. Then we describe our data and the variables we employ to examine the consequences of channel elimination. Next we present our empirical model and report our results. We end with a discussion of managerial implications, limitations, and avenues for future research.

LITERATURE REVIEW

In a customer management context, Neslin et al. (2006, p. 96) define a channel as “a customer contact point, a medium through which the firm and the customer interact” Factors such as enhanced technological capabilities, customer demand, competitive innovation in channel usage, and the promise that a multichannel strategy will help the firm win customers and increase sales and profits, have encouraged firms increasingly to rely on multiple
channels (Blattberg, Kim, and Neslin 2008). Research on channel choice has identified several determinants of customer channel decisions, including: customer purchase history (Ansari, Mela, and Neslin 2008; Fader, Hardie, and Lee 2005), historical channel usage patterns (Gensler et al. 2011), socio-demographic characteristics (Kushwaha and Shankar 2008; Strebel, Erdem, and Swait 2004) and marketing communications (Ansari, Mela, and Neslin 2008; Thomas and Sullivan 2005). Studies have also found that customer responses may vary over time as customers become acquainted with and adopt new channels (Deleersnyder et al. 2002; Venkatesan, Kumar, and Ravishanker 2007). Valentini, Montaguti, and Neslin (2011) find, for example, that the customer choice process for purchase channels evolves over time from the moment customers are acquired, moving from a marketing responsive process to one less influenced by marketing.

Previous research reveals that a multichannel strategy offers several positive consequences, as multichannel customers tend to buy more (Blattberg, Kim, and Neslin 2008; Venkatesan and Kumar 2005). Moreover, research suggests positive consequences of channel additions for firm value (e.g., Geyskens et al. 2002). Yet the use of multiple channels carries risks such as channel cannibalization (Deleersnyder et al. 2002; Pauwels and Neslin 2008; Wolk and Skiera 2009), cross-channel conflicts (Sa Vinhas and Anderson 2005), and poor return on investment (Stone, Hobbs, and Khaleeli 2002). In fact, Chu, Chintagunta, and Vlicassim (2007) found that Dell benefited from exiting the retail channel in 1994. Van Nierop et al. (2011) show that adding the Internet as an information or search channel reduces purchase frequency in a department store. Moreover, the use of more channels might become complex and rather costly (Diakova 2005; Neslin and Shankar 2009). Finally, research has shown negative attitudinal consequences of forcing customers to use a new (usually more cost-effective) channel (Reinders et al. 2008).
In summary, the multichannel customer management literature shows that channel choice can be predicted, along with purchase incidence and order size. Substantively, there is evidence for and against the addition of channels, and some initial evidence that eliminating a channel can have positive consequences. In that respect, our research is most closely related to Chu, Chintagunta, and Vilcassim (2008). However, we analyze a different channel, analyze customer-level data and therefore generate insights at that level, and utilize a controlled field experiment.

**FRAMEWORK**

We build a conceptual framework based on Neslin et al. (2006) then operationalize the framework to analyze our field experiment. Figure 1 presents the framework. The firm’s marketing efforts – in this case catalogs and emails – encourage customers to search for information. The customer’s first decision is which channel to use for search – in our case, catalog or Internet. The customer, having obtained the information desired, then enters the purchase phase, where the decisions are whether to purchase and if so, how much to spend on the order and through which channel. After going through this process, the customer updates his or her attitudes and preferences toward the firm, its channels, and desired order size. These in turn influence the search and purchase decisions the customer makes in the future.

[Figure 1 Goes Here]

Our framework includes three noteworthy phenomena. First, a given channel can be used in multiple phases of the process. For example, catalogs are marketing instruments that stimulate search, and can also serve as a search channel. I.e., receiving a catalog may stimulate the customer to browse through the catalog to see what is available. Second, there is a natural affinity between certain channels. This can be due to channel “lock-in” or synergies between channels (Verhoef et al. 2007; Blattberg et al. 2008, p. 647). For example,
catalogs as a search channel naturally link to telephone as a purchase channel. (The customer reads the catalog and uses the phone number displayed in the catalog to place the order.) As another example, email naturally stimulates search and eventually purchase on the Internet (Ansari et al 2008, see also Venkatesan and Kumar 2004 and Petersen and Kumar 2009). This phenomenon is denoted by the solid lines linking channels with high affinity and dotted lines linking channels with less natural affinity.

Third, marketing efforts, firm preference, and channel preference can moderate the progression through the customer’s multichannel decision process. For example, searching on the catalog might normally lead to a telephone purchase. However, an email can interrupt this process and route the customer to the Internet. As another example, customers may prefer the catalog as a search channel but prefer the Internet as a purchase channel, so this would moderate the normal flow of catalog search to telephone purchase and route the customer to the Internet for purchase. These moderation effects will translate to interaction terms in our statistical model and suggest that channel elimination will have different effects depending on email marketing levels, firm preferences, and channel preferences.

Figure 2 shows how we adapt our framework to analyzing the field test. Likewise most customer databases, we do not have information on customer search. However, we have direct measures of marketing efforts and purchase behavior. We know whether the customer purchased in the current period, and if so, the order size and the channel through which the purchase was made. We also know whether the customer was in the catalog elimination group. In addition, we know whether the customer receives emails from the company.

[Figure 2 Goes Here]

We can also use the data to infer customer preferences. The indicators of firm preference are: (1) Purchase frequency prior to the beginning of the field test, and (2) A zero-
one indicator of “state dependence,” i.e., did a purchase take place last period? To the extent that the customer purchased several times prior to the field test and during the field test purchased recently, he or she has high preference for the firm. The indicators for channel preference are: (1) Customer loyalty to the telephone channel at the beginning of the field test\(^3\), (2) A state dependence variable of whether the telephone was used as the purchase channel on the previous purchase, and (3) A state dependence variable of whether the Internet was used as the purchase channel on the previous purchase\(^4\). To the extent that loyalty to the telephone is high and the telephone was used for the previous purchase during the field test, the customer prefers the telephone as a purchase channel. The indicators of order size preference are: (1) Average order size before the beginning of the field test, and (2) Order size of the previous purchase during the field test. To the extent that the customer begins the field test with a high average order size and during the field test has high order size on the previous purchase, this customer prefers high order sizes.

Note importantly in Figure 2 that following the moderating effects suggested in Figure 1, we expect moderation effects in operationalizing the conceptual framework. That is, customer preferences and firm-delivered emails will moderate the impact of catalog elimination on purchase. We proffer specific hypotheses in the next section, but for now, it is important to see that these moderation effects derive from our original conceptual framework.

**HYPOTHESES**

*Main Effects of Channel Elimination*

**Effect on Purchase Incidence:** We expect that elimination of the catalog decreases purchase incidence because the catalog serves as both marketing and a search channel. The

---

\(^3\) Since we define telephone loyalty to be the percentage of purchases made via telephone and there are only two channels, we do not need a separate Internet loyalty variable.

\(^4\) Note that the customer can use two channels in the same time period to make two purchases and hence we have state dependence variables for each channel.
role of the catalog as a marketing device is to stimulate search (Diakova 2005; Venkatesh 2005; Petersen and Kumar 2009). Furthermore, the elimination of the catalog as a search channel will interrupt the normal flow from catalog search to telephone purchase and hence create reactance and dissatisfaction (Reinders et al. 2008). As a consequence customers should be less likely to purchase.

Effect on order size: Purchase incidence appears to be more malleable than order size in a multichannel environment. Ansari, Mela and Neslin (2008) found that marketing had a significant impact on purchase incidence but not on purchase quantity. In the same vein Pauwels and Neslin (2008) found that the addition of a channel grew sales by increasing purchase incidence without an impact on order size. It is reasonable to expect that order size is determined mainly by initial needs in place before the start of the process. We therefore expect that catalog channel elimination will not affect order size.

Effect on channel choice: Eliminating the catalog channel will affect channel choice because of the natural affinity between the catalog and telephone channels noted earlier. Thus eliminating the catalog channel in the search phase will likely reduce the use of the telephone channel in the purchase phase, and therefore increase use of the Internet for purchase. Research shows that consumers consider online shopping and catalog shopping to be closer substitutes than any other pair of channels (Ward, 2001). In short, eliminating the catalog will drive more customers to search online for the firm’s products, as this is the only remaining search channel. They naturally will then purchase via the Internet.

We hypothesize

\[ H_1: \text{ Eliminating the catalog search channel will decrease purchase incidence.} \]
Conditional on purchase, eliminating the catalog search channel will (a) have no effect on order size per purchase, but (b) induce a substitution of the Internet for the telephone as a purchase channel.

Hypotheses 1 and 2 describe the main effects of channel elimination on our studied dependent variables. However, Figures 1 and 2 also suggest there will be moderating effects. We will only discuss the moderating role of these variables on purchase incidence and channel choice, as we do not expect a main effect of channel elimination on order size.

**Moderating Effect of Firm Preference**

As discussed earlier, Figure 2 shows that we use pre-field test purchase frequency and within-field test purchase state dependence as measures of firm preference. Purchase frequency can be viewed as baseline loyalty for the firm. State dependence varies over time, and can be interpreted as a measure of inertial or habitual loyalty.

We expect that the negative impact of catalog elimination on purchase incidence will be less severe for loyal customers, measured either by baseline loyalty or state dependence. First, loyal customers are also usually more satisfied (Verhoef, Franses and Hoekstra 2002), which induces them to look ahead to the post-purchase satisfaction they will get from the company’s product (Bolton 1998; Oliver and Winer 1987). They should thus be willing to search in another channel even if the catalog is their preferred search channel. Second, prior research has shown that past loyalty may inure consumers from negative firm actions such as the elimination of a preferred channel (Shankar, Smith, and Rangaswamy 2004; Smith and Gupta 2002; Wallace, Giese, and Johnson 2004). These arguments suggest that the negative effect of channel elimination will be less strong for loyal customers. We thus, hypothesize:
H3: Customer preference for the firm as indicated by (a) a customer’s pre-field test total number of purchases, and (b) purchase state dependence will reduce the negative impact of channel elimination on purchase incidence.

Moderating Effect of Channel Preference

We measure channel preference using percentage of purchases made via telephone prior to the field test (baseline telephone loyalty), and inertial loyalty toward the telephone or Internet (state dependence). Focusing first on the impact on purchase incidence, eliminating the catalog should create dissatisfaction especially among customers who historically use the telephone for purchase, because the catalog provided them with a natural and convenient link to this preferred purchase channel. Therefore, telephone loyalists should be especially less likely to purchase from the firm after catalog elimination. We thus hypothesize:

H4: Pre-field test loyalty to the telephone will increase the negative impact catalog channel elimination on purchase incidence.

Turning now to channel choice, the customer who is baseline loyal to the telephone yet still purchases from the firm even when the channel is eliminated has adapted to the change and is using the Internet as a search channel. In turn this customer should be more likely to purchase from the Internet (and less likely to purchase via telephone). We therefore hypothesize:

H5: Customers with high pre-field test loyalty to the telephone, yet who continue to purchase from the firm, will shift purchases from the telephone to the Internet.

Finally we consider the potential interaction between channel state dependence and channel choice. State dependence indicates habitual, inertial behavior. As noted earlier, with fewer options available, it is easier for the customer to be inertial. Also, when a change in the marketing environment occurs, customers can resort to inertial behavior as a simplifying heuristic (see Valentini, Montaguti, and Neslin 2011). Therefore among customers making a
purchase and hence having to choose a channel, we should see more inertial behavior. We therefore hypothesize:

\( H_6: \) The extent of inertial channel choice should increase with channel elimination, creating a positive interaction between state dependence and channel elimination in the channel choice decision.

**Marketing Communication**

In the absence of catalogs, it stands to reason that customers who used to peruse the catalog will pay more attention to a firm’s emails, since emails are now the firm’s primary means of communicating with the customer. The effectiveness of emails should therefore increase. This means emails should mitigate the impact of channel elimination on purchase incidence. Moreover, emails tend to induce choice of the Internet channel (Ansari, Mela and Neslin 2008), However, since former catalog users are now paying more attention to emails and these customers are more likely to use the telephone, the impact of emails on routing customers to the Internet should be mitigated. Hence we hypothesize:

\( H_7: \) Email communication will decrease the negative impact of catalog elimination on (a) purchase incidence and (b) decrease the impact of catalog elimination on Internet substitution for the telephone channel.

**Dynamics of Channel Elimination**

Previous research finds dynamic effects of changes in marketing (Ansari et al. 2008; Leeflang et al. 2009; Pauwels et al. 2011). We are interested whether the negative effect of the catalog channel elimination on customer behavior changes over time. Consistent with the feedback process shown in Figure 1, Valentini, Montaguti, and Neslin (2011) suggest that channel choice evolves over time as customers learn. This learning process will mitigate the initial
negative impact of the catalog channel elimination, because at least some customers will learn how to exclusively use the online channel as a search channel. More evidence can be found for such learning effects. Sloot, Fok, and Verhoef (2006) reveal that the negative effect of retail assortment reductions on sales diminishes slowly over time, because customers adapt to the new assortment. Finally, customers eventually may forget the role that the catalog played in their decision process and hence return to “normal” in the long run. Gönül, Kim and Shi (2000) found a forgetting effect for catalog mailings. Mehta, Rajiv and Srinivasan (2004) found a forgetting effect in customer brand choice over time. Hence, we hypothesize:

\[ H_8: \text{The negative effect of eliminating the catalog search channel on (a) purchase incidence, and (b) telephone channel choice should decrease over time.} \]

**RESEARCH METHODOLOGY**

**Field Test**

We obtained data from a large Dutch catalog retailer that sells a variety of household and personal products through the Internet and telephone channels. This retailer started as a cataloger. It mailed its catalog twice a year to customers listed in their customer database. Hence, the catalog was their main information channel. They used two purchase channels: mail order and telephone. In 2000 this retailer adopted the online channel. Over time mail orders vanished and the Internet and telephone became the two main purchase channels. The Internet has become the dominant purchase channel, accounting for more than 70% of purchases. However, the retailer still sends print catalogs to their customers. One important question is whether they should continue this practice. They therefore aimed to assess the effect of eliminating the channel and executed a field test. The catalog was no longer mailed
to a treatment group of 25,000 for a period 28 months starting in October 2006, while a control group of similar size still received the catalog.

Our data span 60 months from January 2004 to January 2009. For our analysis we draw a random sample of 5,879 customers. The channel elimination field test begins in October 2006. We use the first 32 months (January 2004 - September 2006) as an initialization period to compute variables such as channel loyalty and purchase frequency. We use the next 28 months (October 2006 - January 2009) as the analysis period. Our data show that 55.2% of the customers are multichannel as they use both the Internet and telephone, whereas 25.0% only use the Internet, and 19.8% only use the telephone.

Data

Our data come from customer purchases aggregated to the monthly level (Ansari et al. 2008). These data are based either on customer behavior in the initialization period or the analysis period. Table 1 shows the definitions of variables computed from these data.

 Initialization period

Table 1 shows we compute Baseline Firm Loyalty, Baseline Order Size, and Baseline Telephone Loyalty using the initialization period. These correspond to “Purchase Frequency,” “Average Order Size,” and “Telephone loyalty” in Figure 2.

 Analysis period

We define Catalog Elimination to equal 1 for the customers who were subject to catalog elimination, and 0 for control group who still received the catalog during the field test. We calculated four state dependence variables: Purchase State Dependence based on whether the customer purchased in the previous month, and Last Order Size, Telephone State
Dependence, and Internet State Dependence based on what the customer did on the previous purchase. These correspond to Purchase$_{t-1}$, Order Size$_{t-1}$, Telephone Choice$_{t-1}$, and Internet Choice$_{t-1}$ in Figure 2.

Some customers receive email communications from the retailer. We use a dummy variable Email Communications, equal to 1 if the customer receives email marketing communications and 0 if he or she does not. This corresponds to Email in Figure 2.

**Econometric Model**

To examine the impact of the catalog on customer behavior, we model purchase incidence, channel choice and average order size (in Euros) per purchase. Following Ansari, Mela, and Neslin (2008), we assume that each customer decides each month whether to purchase and, if so, which channel to use and how much to spend.

As an overview, we employ a binomial probit model to determine whether a customer makes a purchase in a given month. We employ a bivariate probit model to determine which channel the customer uses, conditional on purchase in a given month. We use bivariate probit because it is possible the customer uses both channels in a given month. Finally, we use a regression to determine order size for a given purchase, conditional on purchase in a given month. We control for selectivity bias in the choice and order-size models by linking these models explicitly to the purchase incidence model.

We first define the variables used in the model:

- $P^*_it$ = Latent utility of customer $i$ for purchasing in month $t$.
- $H_{it}$ = Set of variables that influence $P^*_it$.
- $P_{it}$ = 1 if customer $i$ makes a purchase in month $t$; 0 otherwise.
- $C^*_itm$ = Latent utility of customer $i$ for purchasing on channel $m$ in month $t$.
- $K_{itm}$ = Set of variables that influence $C^*_itm$.
- $C_{itm}$ = 1 if customer $i$ utilizes channel $m$ for purchase in month $t$. 

16
$Q_{it}^*$ = Utility for order size $Q$ for customer $i$ in month $t$.

$G_{it} = $ Set of variables that influence $Q_{it}^*$

$Q_{it} = $ Order size for customer $i$ in month $t$.

The observed channel choice ($C_{it}$) and order size ($Q_{it}$) are conditional on there being a purchase. This is where selection bias may occur, as only particular customers may decide to purchase in a given month. The total set of equations is as follows:

1. \[ P_{it} = \text{Purchase if } P_{it}^* > 0; \text{ No purchase if } P_{it}^* \leq 0 \]
   \[ P_{it}^* = \alpha_i H_{it} + \epsilon_{it} \]

2. \[ C_{itm} = 1 \text{ if } C_{itm}^* > 0; \text{ and 0 otherwise} \]
   \[ C_{itm}^* = \gamma_i K_{it} + \delta_{it} \]

   where $m = 1,2$ (telephone and the Internet)

3. \[ Q_{it} = Q_{it}^*, \text{ if } P_{it}^* > 0; \text{ unobserved if } P_{it}^* \leq 0 \]
   \[ Q_{it}^* = \beta_i G_{it} + \eta_{it} \]

To control for selectivity, we allow the error term $\epsilon_{it}$ to correlate with the error term $\delta_{it}$ and $\epsilon_{it}$ to correlate with the error term $\eta_{it}$.

The equations for purchase incidence, channel choice and order size contain different explanatory variables ($H_{it}, K_{it}$ and $G_{it}$). The composition of vectors $H_{it}, K_{it}$ and $G_{it}$ entails the following general form:

1. \[ H_{it} = h(CE_i, CCB_{it}, BCB_{it}, M_{it}, T_{it}, CE \times CCB_{it}, CE_i \times BCB_{it}, CE_i \times M_{it}, CE_i \times T_{it}) \]
2. \[ K_{it} = k(CE_i, CCB_{it}, BCB_{it}, M_{it}, T_{it}, CE \times CCB_{it}, CE_i \times BCB_{it}, CE_i \times M_{it}, CE_i \times T_{it}) \]
3. \[ G_{it} = g(CE_i, CCB_{it}, BCB_{it}, M_{it}, T_{it}, CE \times CCB_{it}, CE_i \times BCB_{it}, CE_i \times M_{it}, CE_i \times T_{it}) \]

where
\( CE_i \) = channel elimination,

\( CCB_i \) = current customer behavior (based on purchases in the analysis period),

\( BCB_i \) = baseline customer behavior (based on the initialization period),

\( M_i \) = marketing (email) communications,

\( T_i \) = time effects

See Table 1 for the specific variables that comprise CCB and BCB; note they differ for each equation, and Table 2 for which variables are included in which equation. We use a square root time variable to capture the hypothesized trend effects.

[Table 2 Goes Here]

To enhance the interpretation of our model estimates, we mean-center all covariates except for channel elimination \( CE_i \), by taking \( X_i - \bar{X} \) for each covariate. Mean-centered variables are then used to create interaction terms of \( CE_i \) with the covariates.

**RESULTS**

Table 3 shows the correlation matrix of the variables, indicating no severe multicollinearity. The highest correlation is between Last Order Size and Baseline Order Size (0.514), which is to be expected since the order size in the test period should be related to the average order size in the initialization period. While the correlations between the variables are not extraordinarily large, note the correlations between these variables and their interactions formed by multiplying them by channel elimination (CE) create larger correlations.

[Table 3 Goes Here]

**Purchase Incidence Model**

We provide the parameter estimates for the purchase incidence model in Table 4.
Main Effects

Catalog Elimination: We find a significant and strong negative effect of Catalog Elimination on customer purchase incidence \( (p < .00) \). This shows that the elimination of the catalog search channel decreases customers’ purchase probabilities. This supports H1.

Other variables: Firm preference measured by Baseline Firm Loyalty and Purchase State Dependence both have a strong positive impact \( (p < .00) \) purchase incidence. Email communications exert a positive and significant effect on purchase incidence \( (p < .00) \). These results are as expected. Interesting, we find a significant and positive impact of Baseline Telephone Loyalty on purchase incidence \( (p < .00) \). This suggests that telephone-loyal customers are the firm’s best customers. Finally we find a significant and negative Time Trend \( (p < .00) \); that is, purchase incidence in general is decreasing over time.

Interactions with Catalog Elimination

The interaction between Catalog Elimination and Baseline Telephone Loyalty is significantly negative \( (p < .00) \). That is, customers who are loyal to telephone channel for their purchases are affected more negatively by elimination of the catalog. This supports Hypothesis 4 and suggests that telephone loyal customers are more likely to use the catalog as their main information search channel whereas customers who purchase more from the web use the online channel more intensively for search.

Contrary to H7, our results do not reveal a significant interaction between Catalog Elimination and Email Communications, which implies that email communications do not alleviate the negative effect of catalog elimination on purchase incidence. Our results reveal no significant interaction between Catalog Elimination and Baseline Firm Preference nor Purchase State Dependence, contrary to H3. By itself this says that strong preference for the
firm does not insulate the customer from channel elimination. However, as noted above, telephone loyalists are also more loyal to the firm and their purchase probabilities are especially diminished by catalog elimination. Finally, interaction between Time Trend and Catalog Elimination is positive but not significant. This is contrary to H8a. Note that while H3, H7, and H8a are not supported, the signs of the coefficients were as expected.

The key finding in terms of purchase incidence is that eliminating the catalog channel decreased sales for customers who were loyal to the telephone channel. This effect was not mitigated by firm loyalty, marketing communications (i.e., email), nor the passage of time.

Channel Choice Model

We provide the parameter estimates for the channel choice model in Table 5. Recall that we jointly estimate two equations for the channel choice – one for telephone and one for the Internet channel. Therefore, in order to interpret the results, often it will be necessary to look at the coefficients for a given variable in both models to see for example whether that variable shifts purchases from the telephone to Internet, etc.

[Table 5 Goes Here]

Main Effects

Catalog Elimination: Elimination of the catalog channel has a negative and significant effect on telephone utility ($p < .00$); the impact on Internet utility is not significant. This means that on a net basis catalog elimination decreases utility for the telephone relative to that of the Internet. This makes sense: The catalog as a search channel aligns with the telephone. So eliminating the telephone’s “feeder” makes the telephone less attractive. However,

---

5 This model was estimated in LIMDEP-NLOGIT using simulated maximum likelihood. It did not converge perfectly when we allowed the correlations between equations to be freely estimated. We believe this is because joint choices of Internet and telephone occurred only approximately 5% of the time. The result was a highly negative correlation between the error terms of these equations. When we constrained the correlations, convergence was much improved as measured by the directional derivatives. The constrained correlations were -
eliminating the catalog does not affect utility of the Internet because this channel does not usually feed the Internet. The net result is that catalog elimination will shift purchases from the telephone to the Internet, consistent with H2a.

Other variables: We find that Email Communications has a positive and significant effect utility for the Internet ($p < .00$) whereas it has a negative and significant effect on telephone channel utility ($p < .00$). This shows that emails steer customers from the telephone to Internet. Next we find that Telephone State Dependence has a positive impact on telephone channel utility ($p < .00$) likewise Internet State Dependence has a positive impact on Internet utility ($p < 0.00$). This makes sense in that state dependence reflects inertial loyalty for the channel used on the previous purchase occasion. Also not surprisingly we find a positive and significant impact of Baseline Telephone Loyalty on telephone utility ($p < .00$) and a negative and significant impact on Internet utility ($p < .00$). Finally we find negative and significant trend effect for the telephone and a positive and significant effect for the Internet (both $p < .00$). This shows that the telephone is decreasing in popularity over time relative to the Internet. That is, a voluntary channel migration is in progress for catalog retailers through which the telephone purchase channel is replaced by the online purchase channel over time.

Interactions with Catalog Elimination

First we find no significant interaction between Email Communications and Catalog Elimination. This means that emails do not counter the impact of catalog elimination, contrary to H7b. Next we find that both telephone ($p < .00$) and Internet ($p < .00$) state dependence variables have positive and significant interaction effects with channel elimination. This shows inertial loyalty as reflected by state dependence becomes stronger once the catalog is eliminated, consistent with H6. Also as hypothesized, we find a negative interaction between

---

0.99 between the Internet and telephone equations, and 0.00 between the incidence selection equation and each of the channel utility equations.
Baseline Telephone Loyalty and Catalog Elimination on telephone utility \((p < .00)\) and a positive and significant interaction effect on Internet utility \((p < .00)\). This confirms that heretofore loyal telephone users who continue to purchase switch from the telephone to the Internet, confirming H5. Finally we find no significant interactions between Time Trend and Catalog Elimination either for telephone or for Internet utility, contrary to H8b. However the positive sign for trend in the telephone equation, coupled with a negative sign in the Internet equation, implies the recovery potential of telephone purchases over time.

In summary, we find as expected that eliminating the catalog channel switches customers from the telephone to the Internet. The effect is particularly strong for customers who were telephone loyal before the elimination. Also as expected, state dependence becomes more important both for Internet and channel choice. While the signs of the coefficients suggest the telephone recovers over time, this effect is not by itself statistically significant.

**Order Size Model**

Table 6 shows our results regarding the effect of catalog elimination on order size.

[Table 6 Goes Here]

**Main Effects**

*Catalog Elimination.* Contrary to expectations (H2b) we find a significant positive effect of Catalog Elimination on order size \((p < 0.01)\), given that a purchase occurs. That is, customers who continue to purchase after the catalog is eliminated spend more per purchase occasion, even though our earlier results show there are fewer purchase occasions. We did not anticipate this result but the classic economic order quantity (EOQ) model from operations management (Taylor 2004, pp. 696-701) provides a straightforward post hoc explanation. The EOQ model shows that if the cost per order increases, it is optimal to place
larger orders with lower frequency. Our interpretation is that eliminating the catalog increases search costs, which are analogous to order costs in the EOQ model. As a result, order sizes increase and the customer purchases less frequently. This is exactly what we find.

Other variables. Last Order Size has a positive and significant impact on current order size \((p < .00)\). Secondly, Baseline Order Size has a positive and significant effect on the order size \((p < .00)\). These results make sense in that high-order size purchasers continue to purchase high order sizes. Our results reveal a significantly positive trend effect on order size \((p < .02)\). Email communications do not have a significant impact on the order size.

Interactions with Channel Elimination

We had not hypothesized any interactions regarding order size. We do find, however, that higher Baseline Order Size customers tend to purchase even larger orders when the catalog is eliminated. This is consistent with the EOQ model, where the increase in orders due to increased order costs is positively related to the customer’s baseline demand level.

We also note that the Time Trend interaction with Catalog Elimination is not significant but the sign is positive. While none of our trend results were significant, when combined with the joint effects of all variables, they could have an impact on total sales. We will use simulation to investigate this.

SIMULATION OF SALES AND PROFIT IMPACT

In order to examine the managerial significance of our findings, we estimate the impact on total sales and profits. We conduct a simulation for this purpose. The key advantage of the simulation is that it provides standard errors for our estimates. The simulation takes into account the two sources of uncertainty in our analysis: (1) the error terms shown in equations 1-3, and (2) uncertainty in our estimates of the parameters of
equations 1-3, including individual parameter uncertainty as well as correlations between the estimated parameters. Given the nonlinear nature of the mode, and the three equations involved, this cannot be done analytically.

We conducted the simulation using Monte Carlo techniques, simulating the full sample size available to us (46,000 customers) using 500 replications. For each replication, we drew a set of parameters using the point estimates as means and the estimated covariance matrix to capture parameter uncertainty. We then drew a set of error terms using the estimated variances of these error terms and the estimated correlations between them. We then used equations 1-3 to simulate incidence, choice, and order size for each of the 46,000 customers. This constituted one replication. We then re-drew the parameters and error terms 499 additional times to complete 500 replications. We then calculated average sales per customer per month for the catalog elimination group minus the average sales per customer per month for the control group to determine the mean effect, and the standard deviation of this difference across replications to measure the standard error.

Figure 3 shows the sales revenue impact of catalog elimination, per customer per month – catalog elimination group minus control group. The effect is negative (because of the negative main effect of catalog elimination) and initially statistically different than zero. However, the effect diminishes slightly over time and eventually is not quite significantly different than zero. This is due to the net impact of the positively signed trend/catalog elimination interactions for purchase incidence and order size, and the positively signed state dependence/catalog elimination interaction in the incidence model.

[Figure 3 Goes Here]

To arrive at the total 28-month profit impact, we considered four factors:

1. Change in sales revenues (Figure 3)
2. Profit margin contribution

3. Savings due to fewer orders from the call center (Table 5)

4. Savings due to eliminating catalogs

The change in sales revenues and hence profit contribution is negative but can be offset by cost savings from lower usage of the call center and the elimination of catalogs.

The decreased usage of the telephone channel call center is shown in Figure 4. This is computed from our simulation. The figure shows that the percentage of purchases that utilized the telephone decreased by 4.3 percentage points per month on average. We determined from the company that provided the data that the average call lasts five minutes and costs 0.25 Euros per minute. So we save 1.25 Euros for each order that is shifted from the telephone to the Internet.

[Figure 4 Goes Here]

The catalog cost (printing and mailing costs) is 5 € per customer per mailed catalog. In the field test the company continued to send catalogs to households in the control group (5 catalogs per household × 5 €), while they stopped catalog mailings for the catalog-elimination group. Therefore the firm saves 25 € per customer by eliminating the catalog.

Secondary research suggests that the average contribution margin (revenues – costs of goods sold (margin does not include housing, personnel, and marketing costs)) for non-food retailing is 33% in the Netherlands (Hoofdbedrijfsschap Detailhandel 2011). Further discussion with industry experts suggests that accounting for other costs results in a margin of approximately 25%. We therefore use 25% in our calculations but also solve for a breakeven margin as a sensitivity analysis.

We first calculate the profit impact accounted for by the change in sales and change in telephone usage. These effects must be jointly simulated since the equations of our model
(incidence, channel choice, and order size) are inter-related. The savings from fewer catalog savings is deterministic (25 € per customer), so does not have to be simulated. Our 95% confidence interval for the change in revenues is -48.46 € ± 31.84 €, or multiplying by the 0.25 profit margin, a gross profit change of –12.12 ± 7.96. When we add in the savings due to fewer telephone calls, the impact changes slightly, to -11.80 € ± 7.92 €. The impact of fewer phone calls is not very large. This is because savings for one less phone call is 1.25 €, but there are not that many fewer phone calls per customer (we calculated from the simulation that the average customer makes 0.25 fewer phone purchases over the 28-month period as a result of catalog elimination; 0.25 × 1.25 € = 0.31 €, which is the additional mean savings when we add in the telephone savings (-11.80 – (-)12.12)).

Now however we add in the 25 € savings per customer due to decreased catalog mailing. This shifts our confidence interval by 25 €, so the net profit impact of the catalog elimination is 13.20 € ± 7.92 €, or a range of 5.27 € to 21.12 € with 95% confidence. We calculated a breakeven profit margin by finding the profit margin so that the lower bound of this confidence interval equals zero. That breakeven turned out to be 32%.

Overall our results suggest that the catalog elimination was profitable over a 28-month period. There was a significant loss in revenues, but only 25% of this is profit contribution so the profit loss is not as large. On the plus side, the major savings come from eliminating the cost of printing and mailing the catalog. The additional savings from shifting sales from the telephone call center to the Internet were not influential because the cost of the call center is not very high and not enough purchases are shifted to the Internet to account for much savings. These numbers of course are specific to our application, but illustrate how the various gains and losses from eliminating a channel can balance out.
DISCUSSION

After a period of rampant additions to firms’ channel repertoires, managers now are asking whether they should eliminate certain channels. Prior research on multichannel customer management however has mainly focused on the impact of channel additions (e.g., Ansari et al. 2008; Pauwels et al. 2011; van Nierop et al. 2011) and has almost completely ignored behavioral and profit consequences of channel eliminations. Answering the call for more research on this part of multi-channel customer management (Neslin and Shankar 2009), we use a field experiment to study the effect on customer behavior of eliminating the print catalog channel. We investigate how catalog elimination affects purchase incidence, channel choice and quantity across different retail channels. We also assess whether these effects differ across customers or decrease over time.

We utilized a customer decision framework to derive hypotheses for how customers would react to channel elimination. Our hypothesis testing results are summarized in Table 7. First, catalog elimination indeed decreases purchase incidence. It is noteworthy that the catalog is “only” a search channel, yet eliminating that search opportunity decreases the number of purchase made by customers. In terms of our framework in Figure 1, catalogs play a valuable role in the customer decision and one cannot eliminate it with impunity. Second, catalog elimination drives customers to purchase online. These main effects on purchase incidence, and particularly online sales, has been the topic of significant discussion (Diakova 2005; Szeto and Jimenez 2005; Venkatesh 2005) but never of empirical research that investigated these effects in an actual setting, as we do.

[Table 7 Goes Here]

Third, various factors moderate the impact of eliminating the catalog channel. With respect to purchase incidence, we find that baseline-loyal customers, i.e. customers who
purchase frequently from the firm prior to catalog elimination, are not immune from catalog elimination. We had hypothesized they would be, however the results do not bear this out. We hypothesize and find that the hardest hit customers, i.e., the ones most likely to purchase less frequently, are the customers loyal to the telephone purchase channel, which is the channel naturally aligned with the catalog search channel. We had hoped to find that email marketing would diminish the negative impact of catalog elimination, but found it did not. This further suggests that the catalog plays a key role as a marketing device in addition to a search channel. Moreover, it also signals that emails do not substitute for the catalog.

Regarding channel choice, we find that erstwhile telephone loyal customers do switch to the Internet. Also, inertial channel choice behavior is enhanced by channel elimination. This is an interesting and novel findings. It shows that when faced with fewer search channel options, customers become more consistent in their choice of channel for purchase.

Fourth, we hypothesized catalog elimination would not influence order size, but our findings are that catalog elimination increased order size, especially among customers with high baseline order sizes. In retrospect and as pointed out earlier, this is consistent with the economic order quantity (EOQ) model used in operations management. That model derives analytically that increases in order costs beget higher order sizes, especially among customers with higher baseline demands. It is natural to interpret order costs in the operations context as search costs in the shopping context. Indeed, search has long been recognized as an important cost of shopping (Srinivasan and Ratchford 1991). While the Internet has been associated with decreased search costs (Lynch and Ariely 2000), in our case, clearly search costs increase for the customer who formerly had both the catalog and Internet to use for search, and now just has the Internet. Since search costs increase, the EOQ model becomes applicable and customers buy less frequently with higher order sizes per purchase.
Finally, we hypothesized there would be strong recovery in purchase incidence and channel choice. However, while the signs of these interaction effects were in the hypothesized direction, they did not approach statistical significance. We did find some evidence of recovery in our sales simulation, but this was after combining the impact of individually not statistically significant positive trend/catalog elimination interactions in purchase incidence and order size. Hence, apparently there are no learning effects as we discussed in our theory section. The results also contrast with prior literature on assortment reductions, which shows that in the long-run the negative sales effects of such a reduction fade away (Sloot, Fok and Verhoef 2006). One likely explanation for our finding is that by eliminating the catalog a marketing contact disappears, which results in more permanent effects. In conclusion, we find weak if any evidence for recovery when a company eliminates a major search channel.

We also assessed profit consequences of the channel elimination. Our results show that the negative effect of catalog elimination on firm’s revenues per customer is offset by cost-savings realized with catalog elimination. While there is a shift away from the telephone, the shift is not strong enough, and the financial advantages of the Internet over the call center not large enough, to contribute significantly. These results are of course specific to our application but show how these costs can be accounted for, and how they might balance out.

Over and above the specific findings of this research, we support the theoretical framework advanced in Figure 1 and operationalized in Figure 2. That is, channel elimination has a main effect on customer behavior, but this effect is moderated by marketing and customer characteristics. Table 7 shows several of these interactions, as discussed above.

Managerial Implications
Our research has several implications for managers. First, the elimination of costly channels has real cost benefits in multichannel settings, yet managers must expect a loss in revenues and while some customers may shift to the less costly channel (the Internet in our case), the savings need to be appreciable in order for the net gain to be positive.

Accordingly managers should anticipate significant after-shocks following channel elimination and if possible should consider down-grading the focal search channel instead of totally and immediately eliminating it. A firm can diminish its catalog-marketing activities by gradually decreasing the frequency of sending catalogs as well as by sending smaller less costly leaflets.

Various factors influence customer responses to a channel’s elimination, especially past (baseline) customer behavior and channel usage. Therefore, firms need to develop specific strategies for different customer segments to account for their transactional backgrounds and responses. For example, the customers most affected by the elimination of a search channel are the customers who use the purchase channel affiliated with it. (In our case, we eliminated the catalog channel and the customers affected the most were those who use the affiliated telephone channel). As a result, the firm should target these customers with special offers, etc. to keep them from churning. This is especially important because we find that Email communications do not offset the negative impact of catalog elimination on purchase incidence, as they do not function as a full substitute for catalogs.

Specific Lessons for the Firm in This Application

Based on the results of this experiment and analysis of the data, the retailer understood they should definitely reconsider their catalog strategy. The catalogs in this study were, however, very costly and the infrequent mailing schedule created discrepancies between the offered assortment and prices in the catalog and the rapid changing online assortment and
prices. They therefore developed a new catalog strategy. They started to send out much smaller, less costly catalogs more frequently, which were more up to date and mainly aimed to stimulate sales with interesting offers providing clearer directions to the online channel. This relegated catalogs to become more of a need recognition stimulus than a search medium (see Figure 1).

Research Limitations and Further Research

Our research is limited to a specific form of channel elimination, that is, of print catalogs. It has become one of the most common forms of channel elimination in practice, but other forms might extend beyond this setting. For example, companies might eliminate some modern information search channels such as information kiosks or informative call centers or dismantle purchase or after-sales service channels. We strongly encourage researchers to investigate the effects of channel elimination other than that of catalogs.

Several factors that might affect customer responses to channel elimination do not appear in this research. For example, some product categories might be more influenced by the absence of a catalog (or another) channel. Furthermore, we have no attitudinal or psychographic data regarding customers’ attitudes toward certain channels. The consideration of such factors would extend our understanding of the consequences of eliminating a channel, so we encourage researchers to implement new empirical studies that incorporate other covariates that might affect customers’ responses to channel elimination. Finally, the firm’s current channel portfolio might make it easier (or harder) to eliminate a channel. In our case, there were two major search channels – the Internet and the catalog. Eliminating the catalog had a major effect. However, companies that have more search channels (e.g., sales reps, website, search advertising, in addition to the catalog), may be in a more favorable position to eliminate one channel.
Overall, our results benefit from straightforward nature of the data – a multi-year field test – and thus we are confident in our results. In addition, many of our results were hypothesized beforehand, and the unanticipated results regarding order size can be explained using the economic order quantity model. We are encouraged by what we have learned, and believe the limitations listed above provide fertile ground for future research.
REFERENCES

Journal of Marketing Research, 45 (February), 60-76.

Analyzing and Managing Customers,” in International Series in Quantitative Marketing, New York: Springer.

Continuous Service Provider: The Role of Satisfaction,” Marketing Science, 17 (1), 45-65.


Deleersnyder, Barbara, Inge Geyskens, Katrijn Gielens, and Marnik G. Dekimpe (2002), 

Diakova, Elena (2005), “Remote Shopping: Role of Mail, Catalogs and the Internet,” in 


E-Marketer Digital Intelligence (2004), Multi-Channel Shopping Experience, Online Sales 

Curves for Customer Base Analysis,” Journal of Marketing Research, 42 (November), 
415-430.


McNamara, Stephen (2009), “Ryanair to Abolish Check-In Desks,” (accessed September 1, 2009), [available at http://www.bbcnews.co.uk](http://www.bbcnews.co.uk)


Vovici EFM Research (2008), Catalog/Multichannel Issues Survey. Dulles, VA: Vovici EFM.


Figure 1
Framework: The Customer Decision Process in a Multichannel Environment

Figure 2
Operationalization of Framework to Analyze Catalog Elimination Field Test
Figure 3

Simulated Impact of Catalog Channel Elimination on Sales Revenues

Figure 4

Simulated Impact of Catalog Channel Elimination on Telephone Channel Usage
<table>
<thead>
<tr>
<th>Variable (Figure 2)</th>
<th>Label</th>
<th>Variable Group (Equations)</th>
<th>From Where Computed</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalog Elimination</td>
<td>Catalog Elimination</td>
<td>CE.</td>
<td>Customer Descriptor</td>
<td>=1 if customer is subject to catalog elimination</td>
</tr>
<tr>
<td>Email</td>
<td>Email Communications</td>
<td>M.</td>
<td>Customer Descriptor</td>
<td>=1 if customer receives e-mail marketing communications</td>
</tr>
<tr>
<td>Purchase Frequency</td>
<td>Baseline Firm Loyalty</td>
<td>BCB.</td>
<td>Initialization Period</td>
<td># purchases by customer from the retailer</td>
</tr>
<tr>
<td>Average Order Size</td>
<td>Baseline Order Size</td>
<td>BCB.</td>
<td>Initialization Period</td>
<td>the average value of a purchase</td>
</tr>
<tr>
<td>Telephone Loyalty</td>
<td>Baseline Telephone Loyalty</td>
<td>BCB.</td>
<td>Initialization Period</td>
<td>telephone purchases / (telephone purchases + web purchases)</td>
</tr>
<tr>
<td>Purchase&lt;.t&gt;</td>
<td>Purchase State Dependence</td>
<td>CCB&lt;.t&gt;</td>
<td>Analysis Period</td>
<td>=1 if the customer purchased in the previous month</td>
</tr>
<tr>
<td>Order Size&lt;.t&gt;</td>
<td>Last Order Size</td>
<td>CCB&lt;.t&gt;</td>
<td>Analysis Period</td>
<td>order size of the previous purchase</td>
</tr>
<tr>
<td>Telephone Choice&lt;.t&gt;</td>
<td>Telephone State Dependence</td>
<td>CCB&lt;.t&gt;</td>
<td>Analysis Period</td>
<td>=1 if Telephone was used in the last (most recent) purchase</td>
</tr>
<tr>
<td>Internet Choice&lt;.t&gt;</td>
<td>Internet State Dependence</td>
<td>CCB&lt;.t&gt;</td>
<td>Analysis Period</td>
<td>=1 if Internet was used in the last (most recent) purchase</td>
</tr>
<tr>
<td>Time Trend</td>
<td>Trend</td>
<td>T&lt;.t&gt;</td>
<td>Analysis Period</td>
<td>Square root of time period, t = 0,...,27</td>
</tr>
</tbody>
</table>
### Table 2 Variables for the Analytical Framework

<table>
<thead>
<tr>
<th>Variable</th>
<th>Purchase Incidence Model</th>
<th>Channel Choice Model: Telephone</th>
<th>Channel Choice Model: Internet</th>
<th>Order Size Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variables: Constant for Each Customer</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catalog Elimination</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Email Communications</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Variables: Computed from Analysis Period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase State Dependence</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telephone State Dependence</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Internet State Dependence</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Last Order Size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Trend</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Variables: Computed from Initialization Period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline Firm Loyalty</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline Telephone Loyalty</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Baseline Order Size</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td><strong>Interactions (X Catalog Elimination)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE X Email Communications</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CE X Time Spline 1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CEX Purchase State Dependence</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>CE X Telephone State Dependence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE X Internet State Dependence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE X Last Order Size</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CE X Baseline Firm Loyalty</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE X Baseline Telephone Loyalty</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CE X Baseline Order Size</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
Table 3
Correlation Matrix (Channel Elimination and Covariates)

<table>
<thead>
<tr>
<th></th>
<th>Catalog Elimination</th>
<th>Email Communications</th>
<th>Purchase State Dependence</th>
<th>Telephone State Dependence</th>
<th>Internet State Dependence</th>
<th>Last Order Size</th>
<th>Time Trend</th>
<th>Baseline Firm Loyalty</th>
<th>Baseline Order Size</th>
<th>Baseline Telephone Loyalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalog Elimination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.022</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Email Communications</td>
<td>.029</td>
<td>.156</td>
<td>.057</td>
<td>.025</td>
<td>.008</td>
<td>.057</td>
<td>.023</td>
<td>.019</td>
<td>.257</td>
<td>.285</td>
</tr>
<tr>
<td>Purchase State Dependence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telephone State Dependence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet State Dependence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Last Order Size</td>
<td>.002</td>
<td>.030</td>
<td>.083</td>
<td>.023</td>
<td>.009</td>
<td>.023</td>
<td>.009</td>
<td>.019</td>
<td>.257</td>
<td>.285</td>
</tr>
<tr>
<td>Time Trend</td>
<td>.000</td>
<td>.000</td>
<td>.023</td>
<td>.035</td>
<td>.000</td>
<td>.023</td>
<td>.035</td>
<td>.019</td>
<td>.257</td>
<td>.285</td>
</tr>
<tr>
<td>Baseline Firm Loyalty</td>
<td>.019</td>
<td>.257</td>
<td>.285</td>
<td>.077</td>
<td>.277</td>
<td>.022</td>
<td>.022</td>
<td>.022</td>
<td>.257</td>
<td>.285</td>
</tr>
<tr>
<td>Baseline Order Size</td>
<td>.011</td>
<td>.008</td>
<td>.016</td>
<td>.005</td>
<td>.020</td>
<td>.019</td>
<td>.016</td>
<td>.022</td>
<td>.257</td>
<td>.285</td>
</tr>
<tr>
<td>Baseline Telephone Loyalty</td>
<td>.008</td>
<td>.472</td>
<td>.082</td>
<td>.102</td>
<td>-.153</td>
<td>.024</td>
<td>.024</td>
<td>.022</td>
<td>.257</td>
<td>.285</td>
</tr>
</tbody>
</table>
### Table 4
Purchase Incidence Model

<table>
<thead>
<tr>
<th>Main Effects</th>
<th>Coefficient</th>
<th>p-value</th>
<th>Sig.</th>
<th>Coefficient</th>
<th>Inte Cat:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-1.516</td>
<td>0.00</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catalog Elimination</td>
<td>-0.120</td>
<td>0.00</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMail Communications</td>
<td>0.584</td>
<td>0.00</td>
<td>+</td>
<td>0.043</td>
<td></td>
</tr>
<tr>
<td>Purchase State Dependence</td>
<td>0.185</td>
<td>0.00</td>
<td>+</td>
<td>0.029</td>
<td></td>
</tr>
<tr>
<td>Baseline Telephone Loyalty</td>
<td>0.138</td>
<td>0.00</td>
<td>+</td>
<td>-0.120</td>
<td></td>
</tr>
<tr>
<td>Baseline Firm Loyalty</td>
<td>0.056</td>
<td>0.00</td>
<td>+</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Time Trend</td>
<td>-0.018</td>
<td>0.00</td>
<td>-</td>
<td>0.003</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5
Channel Choice Model

#### Model 1: Telephone Cho

<table>
<thead>
<tr>
<th>Main Effects</th>
<th>Coefficient</th>
<th>p-value</th>
<th>Sig.</th>
<th>Coefficient</th>
<th>Inte Cat:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.695</td>
<td>0.00</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catalog Elimination</td>
<td>-0.187</td>
<td>0.00</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMail Communications</td>
<td>-0.786</td>
<td>0.00</td>
<td>-</td>
<td>0.096</td>
<td></td>
</tr>
<tr>
<td>Telephone State Dependence</td>
<td>0.702</td>
<td>0.00</td>
<td>+</td>
<td>0.191</td>
<td></td>
</tr>
<tr>
<td>Baseline Telephone Loyalty</td>
<td>0.987</td>
<td>0.00</td>
<td>+</td>
<td>-0.235</td>
<td></td>
</tr>
<tr>
<td>Time Trend</td>
<td>-0.023</td>
<td>0.00</td>
<td>-</td>
<td>0.002</td>
<td></td>
</tr>
</tbody>
</table>

#### Model 2: Internet Cho

<table>
<thead>
<tr>
<th>Main Effects</th>
<th>Coefficient</th>
<th>p-value</th>
<th>Sig.</th>
<th>Coefficient</th>
<th>Inte Cat:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.253</td>
<td>0.00</td>
<td>+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catalog Elimination</td>
<td>-0.013</td>
<td>0.78</td>
<td>NS</td>
<td>-0.105</td>
<td></td>
</tr>
<tr>
<td>EMail Communications</td>
<td>0.932</td>
<td>0.00</td>
<td>+</td>
<td>-0.105</td>
<td></td>
</tr>
<tr>
<td>Internet State Dependence</td>
<td>0.802</td>
<td>0.00</td>
<td>+</td>
<td>0.207</td>
<td></td>
</tr>
<tr>
<td>Baseline Telephone Loyalty</td>
<td>-1.074</td>
<td>0.00</td>
<td>-</td>
<td>0.252</td>
<td></td>
</tr>
<tr>
<td>Time Trend</td>
<td>0.026</td>
<td>0.00</td>
<td>+</td>
<td>-0.007</td>
<td></td>
</tr>
</tbody>
</table>
Table 6

Order Size Model

<table>
<thead>
<tr>
<th></th>
<th>Main Effects</th>
<th>Interaction Effects</th>
<th>Catalog Elimination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>p-value</td>
<td>Sig.</td>
</tr>
<tr>
<td>Constant</td>
<td>135.994</td>
<td>0.00</td>
<td>+</td>
</tr>
<tr>
<td>Catalog Elimination</td>
<td>8.093</td>
<td>0.01</td>
<td>+</td>
</tr>
<tr>
<td>Last Order Size</td>
<td>0.095</td>
<td>0.00</td>
<td>+</td>
</tr>
<tr>
<td>Email Communications</td>
<td>1.649</td>
<td>0.76</td>
<td>NS</td>
</tr>
<tr>
<td>Baseline Order Size</td>
<td>0.454</td>
<td>0.00</td>
<td>+</td>
</tr>
<tr>
<td>Time Trend</td>
<td>1.550</td>
<td>0.02</td>
<td>+</td>
</tr>
</tbody>
</table>
Table 7
Hypotheses and Summary of Results

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Factor</th>
<th>Decision</th>
<th>Hypothesis</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Catalog elimination (CE)</td>
<td>Incidence</td>
<td>Negative impact</td>
<td>Confirmed</td>
</tr>
<tr>
<td>2a</td>
<td>Catalog elimination (CE)</td>
<td>Choice</td>
<td>Shift from telephone to Internet</td>
<td>Confirmed</td>
</tr>
<tr>
<td>2b</td>
<td>Catalog elimination (CE)</td>
<td>Order Size</td>
<td>No Effect</td>
<td>Positive effect</td>
</tr>
<tr>
<td>3a</td>
<td>CE × Baseline firm loyalty</td>
<td>Incidence</td>
<td>Lessens negative effect</td>
<td>N.S. (“right” sign)</td>
</tr>
<tr>
<td>3b</td>
<td>CE × Purchase state dependence</td>
<td>Incidence</td>
<td>Lessens negative effect</td>
<td>N.S. (“right” sign)</td>
</tr>
<tr>
<td>4</td>
<td>CE × Baseline telephone loyalty</td>
<td>Incidence</td>
<td>Increases negative effect</td>
<td>Confirmed</td>
</tr>
<tr>
<td>5</td>
<td>CE × Baseline telephone loyalty</td>
<td>Choice</td>
<td>Shift from telephone to Internet</td>
<td>Confirmed</td>
</tr>
<tr>
<td>6</td>
<td>CE × Telephone state dependence</td>
<td>Choice</td>
<td>Strengthens state dependence</td>
<td>Confirmed</td>
</tr>
<tr>
<td>7a</td>
<td>CE × Email</td>
<td>Incidence</td>
<td>Strengthens email</td>
<td>N.S. (“right” sign)</td>
</tr>
<tr>
<td>7b</td>
<td>CE × Email</td>
<td>Choice</td>
<td>Shift to telephone</td>
<td>N.S. (“right” sign)</td>
</tr>
<tr>
<td>8a</td>
<td>CE × Time trend</td>
<td>Incidence</td>
<td>Lessens negative effect</td>
<td>N.S. (“right” sign)</td>
</tr>
<tr>
<td>8b</td>
<td>CE × Time trend</td>
<td>Choice</td>
<td>Lessens shift from telephone</td>
<td>N.S. (“right” sign)</td>
</tr>
</tbody>
</table>