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TOWARDS A CONCEPTUAL FRAMEWORK OF OUT-OF-STOCK BEHAVIOUR
The impact of product, consumer, and situation characteristics on out-of-stock reactions

Kathia CAMPO
Els GIJSBRECHTS
Patricia NISOL

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Kathia CAMPO – Postdoctoral Fellow of the Fund for Scientific Research – Flanders; and UFSIA
Els GIJSBRECHTS – Professor of Marketing at UFSIA and FUCAM
Patricia NISOL - Research assistant at UFSIA

UFSIA-University of Antwerp, Faculty of Applied Economics
Prinsstraat 13, B-2000 Antwerp, Belgium
Sandra Verheij - Research Administration - B.112
tel (32) 3 220 40 32 fax (32) 3 220 40 26 e-mail research-fte@ufsia.ac.be

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REVISED VERSION

Katia Campo[1], Els Gijsbrechts[2], Patricia Nisol[3]

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[1] Postdoctoral Fellow of the Fund for Scientific Research Flanders (Belgium), UFSIA-University of Antwerp, Prinsstraat 13, B-2000 Antwerp, Tel +32/3/220.40.64, Email: katia.campo@ufsia.ac.be

[2] Professor of Marketing, UFSIA-University of Antwerp, Prinsstraat 13, B-2000 Antwerp, Tel +32/3/220.41.08, Email: els.gijsbrechts@ufsia.ac.be

[3] Research assistant, UFSIA-University of Antwerp, Prinsstraat 13, B-2000 Antwerp, Tel +32/3/220.42.15, Email: patricia.nisol@ufsia.ac.be

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Abstract

In this paper, we present a conceptual framework that integrates the major determinants of consumers' reactions to out-of-stocks. The theoretical relationships can provide an explanation for the marked differences in out-of-stock effects observed in previous studies. We find support for the conceptual framework in an empirical analysis. The empirical results confirm that out-of-stock responses depend on product, consumer, and situation characteristics, such as the degree of item and store loyalty, the availability of acceptable alternatives, and available time for shopping. Implications for manufacturers and retailers, who can experience serious losses through out-of-stocks, are discussed, and ways are suggested to reduce these losses.

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INTRODUCTION

One of the most remarkable aspects of out-of-stocks (OOS) is the scant attention they received in the marketing literature. In 1979, Schary and Christopher pointed to the fact that "product availability is a major but underemphasized problem in American Marketing", a statement confirmed by Emmelhainz et al. more than 10 years later (Schary and Christopher 1979, p.59, Emmelhainz et al. 1991). From the few empirical studies that have been carried out it is clear, however, that OOS may have important profit implications for manufacturers as well as retailers (see e.g. Walter and Grabner 1975, Emmelhainz et al. 1991, Corstjens and Corstjens 1995). Out-of-stocks can result in substantial losses, depending on the way consumers react: they may switch to another brand, buy another variety or package size of the same brand, go to another store, postpone or simply cancel the purchase. Moreover, the revenue loss not only stems from lost product sales during the OOS period, but can also extend to later periods or other product categories. Consumers who switch to another product or brand may, for example, remain with the substitute product even after the store inventory has been replenished (Schary and Christopher 1979). Others who decide to buy their favorite product in a competing store, may transfer planned purchases in other product categories as well, leading to a loss that extends well beyond the profit margin on the missing product (Corstjens and Corstjens 1995). Finally, in addition to lost profits and sales, out-of-stocks can also have a substantial negative impact on customer satisfaction with the brand and store (Zinszer and Lesser 1981).

Even though the potential importance of OOS consequences goes unquestioned, little is known about what to expect in specific cases. Even within product categories, consumer reactions to and the losses resulting from OOS are found to vary strongly from case to case. Although some attempts have been made to explain the observed heterogeneity in OOS response, it remains largely unaccounted for. Yet, identifying the determinants of OOS reactions may provide crucial insights to both manufacturers and retailers, and may suggest ways to reduce OOS losses through appropriate ordering and inventory policies, shelf space allocation, and channel negotiations.

The objective of this paper is threefold. First, we aim to develop a conceptual framework that integrates the major determinants of OOS reactions, and provides an explanation for observed differences in OOS effects within product categories. Second, we extend previous research by empirically analyzing this set of explanatory variables in a multivariate setting, and assessing their relative importance and interactions. Third, we offer some tentative conclusions for manufacturers and retailers, by pinpointing situations for which OOS result in serious losses, and suggesting ways of reducing or avoiding these losses.

The paper is organized as follows. In the next section, the literature on OOS and their impact on consumer behavior are briefly reviewed. This analysis provides major building blocks for the conceptual framework presented in the third section, from which hypotheses are derived. Next, the data set and methodology used to test these hypotheses are described. In the sections that follow, results are reported and implications for manufacturers and retailers are discussed. We conclude with a summary of major results, and indicate study limitations and directions for future research.

LITERATURE REVIEW

Previous OOS studies are predominantly empirical in nature (Peckham 1963, Walter and Grabner 1975, Zinszer and Lesser 1981, Emmelhainz et al. 1991, Blommaert 1996, Drèse 1997). These empirical analyses provide valuable insights into the importance of OOS for manufacturers and retailers, and into the way people react when the item they intended to purchase is unavailable. As indicated above, buyers can respond in one of four different ways: they can switch to another item of the product assortment, buy the favorite or regular item in a competing store, defer the purchase to a next shopping occasion, or drop the purchase altogether (see e.g. Corstjens and Corstjens 1995). Some researchers make a further distinction between switching to another brand or variety (which will further be

referred to as 'item switching'), and switching to another package size (Peckham 1963, Walter and Grabner 1975, Schary and Christopher 1979, Emmelhainz et al. 1991).

Table 1
Results of previous OOS research, frequency distribution of OOS responses

OOS response	Peckham (1963)	Walter and Grabner (1975)	Schary and Christopher (1979)	Emmelhainz et al. (1991)	Blommaert (1996)	Drèse (1997)
Switch size	52%	19%	5%	19%	14%	-
Switch item	30%	64%	17%	55%	55%	60%
Switch store	}	14%	48%	14%	7%	7%
Defer purchase	} 18%	}	11%	}	}	}
Drop purchase	}	} 3%	19%	} 12%	} 24%	} 32%
Other	-	-	-	-	-	1%

Table 1 reports average frequencies with which each of the OOS reactions were observed in previous studies. These figures clearly demonstrate that distributions of OOS responses vary across studies. This may be due to differences in study settings, research methodology, or product categories. Table 2 summarizes the main characteristics of various studies, and provides tentative explanations for the variation in outcomes. For instance, the percentage of consumers who indicated to switch stores is generally higher in studies that record reactions from consumers who were actually confronted with an OOS. These respondents are likely to be consumers who really looked for the planned product, and are fairly attached to it.

While differences between distributions clearly exist, the study findings also exhibit some regularities. Most studies reveal that, though the majority of consumers choose to switch to another product when confronted with an OOS for their planned or favorite item, other reactions like store switching, deferment, or cancellation are non-negligible, and warrant attention. In other words, even within a given setting, varied consumer reactions to OOS are observed, and the question remains what causes these differences.

Table 2
Characteristics of previous OOS studies

Study	Sample Size	Study settings	Methodology		Other data collected	Categories
			OOS measure	Reaction options		
Peckham (1963)	1173 24% OOS[a]	Several stores 14 categories After shopping 70% end of week	Actual OOS	Switch brand/size/color No purchase	Demographics Shopping pattern Type of store	14:Dentifrice, Floor wax, Instant coffee, Detergent, Salad & cooking oils, Margarine, Toilet soap, Cake mix, Canned beans, Tuna fish, Vegetables & tomato juices, Cereals, Crackers, Toilet tissue.
Walter and Grabner (1975)	1433	10 liquor stores 1 category Questionnaire	Fictitious OOS	Switch brand/size Switch store Defer purchase	Shopping frequency	1 : liquor
Schary and Christopher (1979)	1167 29% OOS[a]	2 stores After shopping 70% end of week	Actual OOS	Switch brand/size/ product Switch store Defer purchase Cancel purchase	Store image Demographics	Not indicated.
Emmelhainz, Emmelhainz and Stock (1991)	2810 13% OOS[a]	1 store 5 categories After shopping Experiment	Actual OOS	Switch brand/variety/size/ Combinat. of the previous/ Product same variety larger size Switch stores Defer purchase Special shopping trip	Demographics Product attributes Perceived risk Intended usage Urgency Purchase pattern Store patronage Store satisfaction	5: Frozen orange juice, Toothpaste, peanut butter, Coffee, Tomato sauce.
Blommaert (1996)	55 respon-dents 118 responses	1 store 5 categories Pannel receipts, questionnaire	Fictitious OOS	Switch to another Item Switch store Defer purchase	Demographics Purchase pattern Type of brand	5: Milk, Chips, butter/margarine, Cereals, Yogurt.
Drèse (1997)	86 respon-dents 249 responses	1 store 13 categories Questionnaire	Fictitious OOS	Switch to another item Switch store Defer purchase Other	Demographics Purchase pattern Type of brand Hedonic value Involvement	13: Chips, Jam, Household paper, Mayonnaise, Toilet paper, Chocolate, Butter, Milk, Toothpaste, Bier, Cereals, Washing powder, Yogurt.

[a] Percentage of respondents who encountered an OOS for a planned product purchase

The studies mentioned above provide partial insights into factors underlying the heterogeneity in OOS responses. Differences in reactions to OOS have been related to product, consumer, and situation characteristics. Perceived risk of product substitution, and degree of loyalty towards the OOS item are found to have a major negative impact on substitution decisions (Schary and Christopher 1979, Emmelhainz et al. 1991). Similarly, consumers' store loyalty is found to reduce the likelihood of store switching (Emmelhainz et al. 1991). For demographic buyer characteristics, in contrast, no or only a limited impact on OOS behavior is observed; except for age where some differential reactions are found (Peckham 1963, Zinszer and Lesser 1981). Situation characteristics with a substantial impact on the probability of item substitution are planned usage (regular versus special usage), and urgency with which the product is needed (Emmelhainz et al. 1991). The impact of a stock-out on customer satisfaction, finally, is found to depend mainly on the consumer's purchase motivation, i.e. on whether a promotion is the major reason for a planned purchase or not (Zinszer and Lesser 1981).

While the empirical studies referred to above provide highly valuable insights, they have two limitations in common. First, they look for empirical associations, but offer no theoretical explanation for the observed relationships. Second, they include only a limited set of explanatory variables, which are related to the OOS reaction in a series of bivariate analyses. As a result, they fail to separate out the impact of different explanatory factors, and they do not allow to derive any 'causal' relationships - as their observed associations might be spurious. Hence, it is difficult to conclude from these studies what OOS reactions can be expected under specific conditions.

Corstjens and Corstjens (1995; C&C), in contrast, made a valuable contribution to the theoretical explanation of OOS behavior. Following these authors, OOS reactions result from a trade off between two cost components: the cost of switching brands (CSB) and the cost of switching stores (CSS). The cost of switching brands is defined as "the marginal satisfaction given up when the shopper substitutes the next best SKU for the unavailable favorite brand/SKU" (C&C, p.199). The cost of switching stores is described

as "the perceived cost to a consumer of making a visit to a competitive store in order to find a missing SKU" (C&C, p.202). In addition to the physical cost associated with the trip to the other store, CSS is assumed to consist of a psychological cost of not making the purchase immediately and of having to purchase the item at another, possibly less preferred, store. Following C&C, a consumer's reaction to an OOS depends on the absolute and relative level of both costs. When CSB is small and lower than CSS, buyers will switch to another item when their favorite one is unavailable. A relatively low CSS combined with a higher CSB, is assumed to result in store switching. When both costs are high, consumers are expected to defer or cancel the purchase. Only when consumers need the product urgently, will they be prepared to carry such high costs.

The framework developed by C&C constitutes an important contribution to the OOS literature, and substantially improves our insights into OOS behavior. Yet, despite its merits, it clearly leaves room for further development. *First*, the framework itself is open to refinement. For one, probably as a result of their focus on the manufacturer-retailer relationship, C&C concentrate on brand and store switching, while treating the decision to defer or cancel the purchase as a 'rest category'. Yet, as will be discussed in more detail in the remainder of this text, the decisions to defer or drop a purchase may each entail specific costs (not included in CSB or CSS) that affect their likelihood of occurrence. Also, C&C exclusively deal with brand/variety switching, and do not allow for a (separate) package size switch reaction to OOS. Recent studies suggest, though, that switching brands or package sizes may be triggered by different mechanisms and motives, and hence should be treated as separate reactions. *Second*, C&C do not empirically test their framework. More importantly, they provide no direct indications on how their framework could be operationalized or tested. The key explanatory variables - CSB and CSS - are not directly observable, nor are there any existing self-report scales that tap these or related concepts.

CONCEPTUAL FRAMEWORK AND HYPOTHESES

As indicated in the introduction, the purpose of this paper is to provide a conceptual and operational framework, that links 'observable' product, consumer, and situation characteristics on the one hand, to OOS reactions within a product category on the other hand. The framework should provide insights into major underlying determinants of OOS responses and yield operational hypotheses with respect to their effect on OOS reactions.

Basic assumptions

In developing our framework of OOS reactions, we build on the OOS literature discussed in the previous section, as well as on the stream of literature that describes consumer decision processes in the context of utility-maximization. Recent articles by Messinger and Narasimhan (1997), and Bell et al. (1998) use this type of models to explain store choice, while Chiang (1995), Bawa and Shoemaker (1987 b) and Narasimhan (1984) adopt a similar approach to explain coupon usage. The basic paradigm behind these models is that consumers engage in household production activities, and allocate time, money and effort in the production of utility. Our premise is that households' decisions on how to react to a stock-out are based on similar utility maximization principles. When confronted with an OOS, households face a number of decision options, each entailing specific costs and benefits. In line with utility theory, we assume that a household's choice will be driven by a trade off between these costs and benefits: households are more likely to pick the option that maximizes 'net benefits' or 'utility' in current and future periods[i].

Like coupon usage, OOS are 'special' events that necessitate a *change* in buying behavior (switch to another item or store, canceling a planned purchase), resulting in additional costs and/or lower than expected benefits compared to the planned or regular purchase decision. Building on the similarity in behavioral change associated with coupon and OOS reactions, we distinguish between the same basic cost types as Bawa and

Shoemaker (1987a,b) to assess the 'utility loss' resulting from an OOS: *transaction costs, substitution costs and opportunity costs.*

Transaction costs are costs incurred to acquire the items. These costs are not exclusively monetary in nature, but include the time and effort cost of shopping activities. Transaction costs can be broken down into search costs (time and mental effort to find a suitable alternative), handling costs (including storage costs), and – in the case of store choice - transportation costs (see e.g. Park, Iyer and Smith 1989, Mulhern and Padgett 1995, Bell et al. 1998). *Substitution costs* are caused by a decrease in utility following a switch to another alternative, because of lower preference and/or higher price. *Opportunity costs* indicate the loss in utility incurred when consumption in the category is reduced or dropped.

Similar to Bell et al. (1998), we integrate these costs and benefits explicitly in a random utility maximization model. Consider a shopper h, who on purchase occasion t, is confronted with a stock-out for his/her regular item in a given product category c. The shopper now faces a number of reaction options j: switching to another item or package size, going to another store, deferring the purchase, or canceling the purchase. Each decision gives rise to specific costs that have to be weighed against each other. The total cost ($C^j_{h,t,c}$) incurred by household h on occasion t, when choosing option j in category c, can be broken down into a substitution cost ($SC^j_{h,t,c}$), a transaction cost ($TC^j_{h,t,c}$), and an opportunity cost ($OC^j_{h,t,c}$) component:

$$C^j_{h,t,c} = SC^j_{h,t,c} + TC^j_{h,t,c} + OC^j_{h,t,c} \qquad (1)$$

Like Bell et al. (1998), we relate this total cost to the consumer's utility for option j by assuming a linear utility function. Additive utility functions have also been used by Chiang (1995) and Narasimhan (1984). The utility of choosing option j for shopper h in category c on occasion t is:

$$U^{j}_{h,t,c} = -C^{j}_{h,t,c} + \varepsilon^{j}_{h,t,c}$$

where

$-C^{j}_{h,t,c}$ = systematic utility component

$\varepsilon^{j}_{h,t,c}$ = random utility component (2)

Assuming that $\varepsilon^{j}_{h,t,c}$ are independent and identically distributed double exponential random errors[ii], the probability that a utility maximizing shopper chooses option j in category c on occasion t is given by:

$$P^{j}_{h,t,c} = \frac{U^{j}_{h,t,c}}{\sum_{k} U^{k}_{h,t,c}} \qquad (3)$$

which is the classical multinomial logit function.

In the next paragraph, we provide a more in depth discussion on the substitution, transaction, and opportunity costs associated with each of the OOS reactions. In a second stage, the basic, yet unobservable costs, are linked to product, consumer, and situation characteristics that may influence the level of these costs. Taken together, both stages lead to an operational framework that provides insights into OOS behavior, and yields testable hypotheses on how product, consumer, and situational variables affect stock-out reactions.

Basic costs associated with OOS reactions

In line with the recent choice literature, OOS responses are analyzed at the SKU-level (see e.g. Fader and Hardie 1996). Like previous OOS studies, we concentrate on OOS reactions for frequently purchased consumer goods. We extend the model of C&C, by explicitly distinguishing between brand/variety switching-designated by the term "item switching"- and package size switching. Also, we consider an extended and more refined set of costs and utilities underlying reactions to OOS, which allows for a better explanation of OOS behavior in general, and of the defer and cancel decisions in particular.

Costs of Item Switching

The decision to purchase another item (brand, and/or variety, referred to hereafter as decision j=I) predominantly entails two types of costs: **item substitution costs** ($SC^{I}_{h,t,c}$) and **transaction costs of item switching** ($TC^{I}_{h,t,c}$). Switching to another item allows to keep consumption at the regular or planned level, and thus avoids any opportunity loss ($OC^{I}_{h,t,c} = 0$). It follows that the total cost of item switching ($C^{I}_{h,t,c}$), which is similar in nature to C&C's "Cost of Switching Brands, or CSB", can be specified as:

$$C^{I}_{h,t,c} = SC^{I}_{h,t,c} + TC^{I}_{h,t,c} \qquad (4)$$

Item Substitution costs can be defined as the loss in utility from having to substitute the planned item by a different item. The utility loss could stem from differences in intrinsic appeal between the OOS item and the substitute item – which may be of inferior quality or belong to a less appealing brand – or from differences in extrinsic attractiveness. For instance, the purchase may have been planned because the OOS item was on promotion, while available substitutes are not. In addition, item substitution costs could be due to the consumer's reluctance to change as such. Following the variety seeking literature and related psychological theories (e.g. Optimal Stimulation Level theory; see Raju 1984, Blattberg and Neslin 1990), a change in choice behavior may in itself be perceived as a 'psychological cost'. Even when close substitutes are available, the tendency to repeat rewarding behavior and the aversion from change may prevent some consumers from switching to another item (see e.g. Mc Allister and Pessemier 1982, Van Trijp et al.1996).

Transaction costs of item switching mainly consist of search costs, i.e. the perceived cost of the time and effort needed to find an acceptable alternative for the OOS item. The cost of choosing products has been found to depend on the complexity of the decision process in the category (Shugan 1980, Dhar 1997). In addition, search costs depend on whether a consumer has access to internal information on several category items, or whether s/he needs to collect the information externally and engage in an active

evaluation process (see e.g. Shugan 1980). Finally, as long as the substitute item has the same package size and is procured in the same store, no additional handling or transportation costs are incurred.

Costs of package size switching

Like item switching, **switching to another package size** (denoted as decision j=PS) does not result in opportunity losses ($OC^{PS}_{h,t,c} = 0$). Moreover, it normally does not result in a lower intrinsic utility, nor is it expected to give rise to substantial search costs. Still, a switch from a regular small package size to a larger pack of the same item may in some cases result in non-zero **substitution costs** ($SC^{PS}_{h,t,c}$) and additional **transaction/search costs** ($TC^{PS}_{h,t,c}$). We therefore specify the cost of package size switching ($C^{PS}_{h,t,c}$) as follows:

$$C^{PS}_{h,t,c} = SC^{PS}_{h,t,c} + TC^{PS}_{h,t,c} \tag{5}$$

Package size substitution costs arise when the switch to a larger package size involves an increase in purchase quantity in excess of the average consumption rate. Consumption of the same package over an extended period of time may come at the cost of product quality and freshness, causing a reduction in the product's intrinsic utility (see e.g. Blattberg et al. 1978). **Transaction costs of package switching** may be due to changes in holding or handling costs associated with the package change.

Costs of store switching

Like item switching costs, costs of store switching ($C^{S}_{h,t,c}$) mainly consist of **store substitution costs** ($SC^{S}_{h,t,c}$) and **transaction costs of store switching** ($TC^{S}_{h,t,c}$). As buying the product in another store allows to avoid consumption reduction, the switch store option does not involve any opportunity loss ($OC^{S}_{h,t,c} = 0$). We therefore have:

$$C^{S}_{h,t,c} = SC^{S}_{h,t,c} + TC^{S}_{h,t,c} \quad (6)$$

Store substitution costs refer to the loss in utility from having to buy the product in a different store. The driving forces underlying store substitution costs are quite similar to those associated with item switches. Assuming that the consumer opted for the store with the lowest overall costs (see Bell et al. 1998), switching stores may increase shopping costs. Shopping costs can be decomposed into a variable and fixed component (Bell et al. 1998). Variable shopping costs are related to the price and quality the store offers for all products on the consumer's shopping list (Messinger and Narasimhan 1997, Bell et al. 1998). If a store switch implies that items other than the OOS item are also procured in the substitute store, this may cause a change in variable shopping costs. Fixed shopping costs depend on factors such as the store image, attractiveness of the store assortment, and service level. To the extent that the favorite store outperforms the replacement store on these dimensions, store substitution may also increase fixed shopping costs (see e.g. Bell et al. 1998, Sirohi et al. 1998). Next, like for item substitution costs, consumers who switch stores may incur an additional 'psychological cost' associated with the consumer's reluctance to change store patronage behavior (Leszczyc and Timmermans 1997).

Transaction costs of store switching refer to the additional time and effort needed from consumers to procure the product elsewhere. These transaction costs encompass the cost of additional shopping time - needed for activities like travel to/from the store, parking, and checkout - and possibly some extra time needed to locate the category and required item in a less familiar store (Messinger and Narasimhan 1997). In addition, search costs may be associated with the mental effort of choosing a suitable alternative store.

Costs of purchase deferment or cancellation

As indicated before, we posit that the decision to defer the planned purchase (decision j=D) or the decision to cancel it (decision j=C) entail specific costs ($C^{D}_{h,t,c}$, $C^{C}_{h,t,c}$, resp.), that make them less desirable. In contrast to item and store switching, these OOS

reactions do not involve any substitution cost ($SC^{D}_{h,t,c} = 0$, $SC^{C}_{h,t,c} = 0$), as the planned item is either purchased at the same store on a subsequent shopping trip or not purchased at all. On the other hand, purchase deferment and cancellation do involve an **opportunity cost** ($OC^{D}_{h,t,c}$, $OC^{C}_{h,t,c}$, resp.), consisting of the utility of the (potentially) foregone consumption. As indicated below, while canceling the purchase does not entail a **transaction cost** ($TC^{C}_{h,t,c} = 0$), consumers who postpone the purchase may face such additional, future costs ($TC^{D}_{h,t,c}$). We therefore posit the following cost expressions for purchase deferment and cancellation:

$$C^{D}_{h,t,c} = TC^{D}_{h,t,c} + OC^{D}_{h,t,c} \tag{7}$$

$$C^{C}_{h,t,c} = OC^{C}_{h,t,c} \tag{8}$$

If the purchase of a product is postponed, the consumer may incur a loss in consumption utility when his/her household inventory is insufficient to cover consumption needs until the next shopping trip. Even if the consumer expects that the household inventory will be sufficiently high, there remains some uncertainty as to whether s/he will 'make it' till the next shopping trip. The uncertainty can be a result of a varying and difficult- to-predict consumption rate, and/or inaccurate information about the exact inventory level. Especially for low involvement products, the assumption that buyers have perfect information on consumption needs and household stocks may be unrealistic (Neslin and Schneider-Stone 1996). Purchase deferment thus entails a risk of foregone consumption. If the purchase is cancelled, consumption will certainly be lower than usual. Both situations therefore imply an **opportunity cost** linked to the (potential) loss in consumption.

In case the consumer decides to postpone the purchase, s/he may anticipate the possibility to return to the store earlier than planned in order to purchase the missing product (Emmelhainz et al. 1991). Like an immediate store switch, shopping trip acceleration will demand some additional time and effort, and hence yield additional transaction costs,

similar in nature to the transaction costs of a store switch. Under the assumption that consumers strive to maximize utility of present and future periods, **transaction costs** of potential shopping trip acceleration will influence the attractiveness of the deferment decision.

Impact of Product, Consumer and Situation Characteristics on Basic Cost Components

Having clarified the basic costs incorporated in our framework, we now turn to the various consumer, product[iii], and situation characteristics influencing these costs. We then formulate hypotheses with respect to their net influence on OOS reactions.

As indicated above, **item substitution costs** depend on the difference in intrinsic utility between the planned and chosen item, and on the consumer's attitude towards change. In the consumer behavior literature, attitude towards change is traditionally related to the consumer's *variety seeking tendency* ($VST_{h,c}$). This consumer characteristic describes whether the buyer tends to seek variation in buying behavior for a given product category in order to satisfy an intrinsic desire for change, or in contrast, tries to avoid variation in behavior because s/he dislikes change (Raju 1980, Hoyer and Ridgway 1984, Givon 1984 and 1985, Van Trijp et al. 1996, Campo 1997).

To assess perceived differences in intrinsic utility, a crucial question is whether the store assortment comprises an acceptable substitute for the OOS item or not (see e.g. Corstjens and Corstjens 1995). Research on consideration set composition and size has demonstrated, that some consumers have single item consideration sets, meaning that utility differences between the favorite and other available items are prohibitively large (Lapersonne et al. 1995). In other cases, perceived utility differences do exist but are deemed less important, and at least one other item is considered to be a suitable consumption alternative. Based on this finding, we posit that substitution costs are inversely related to the *availability of acceptable alternatives* ($AAAI_{h,c}$) in the OOS store.

We further assume that differences in intrinsic utility between the OOS item and available substitutes are closely related to the consumer's *loyalty* for the given category ($ILOY_{h,c}$). The degree of loyalty depends on the consumer's strength of preference in the category, and hence, gives an indication of the perceived difference in utility between favorite and alternative items (Van Trijp et al. 1996). This proposition is in line with the OOS literature, where item loyalty has been described as one of the major determinants of stock-out reactions (Schary and Christopher 1979, Emmelhainz et al. 1991, Corstjens and Corstjens 1995). In addition to intrinsic utility differences, choice alternatives may differ in extrinsic utility. Building on the choice behavior literature, sales *promotions* ($PROMO_{h,c,t}$) can be considered to be one of the most important extrinsic purchase motivations (see e.g. Mazursky et al. 1987). We therefore expect substitution costs to be higher when the consumer had planned to purchase the OOS item on promotion. This leads to:

$$SC^{I}_{h,t,c} = \alpha^{I}_{0} - \alpha^{I}_{1} VST_{h,c} - \alpha^{I}_{2} AAAI_{h,c} + \alpha^{I}_{3} ILOY_{h,c} + \alpha^{I}_{4} PROMO_{h,c,t} \qquad (9)$$

Transaction costs of item switching mainly consist of the search effort needed to find an acceptable alternative, which in turn depends on the complexity of the decision process and the amount of internal product information available to make a selection. Previous research has demonstrated that - for the type of products considered here (frequently purchased consumer goods) - consumers tend to develop simple decision rules through purchase and consumption experience, in order to facilitate choice decisions (see e.g. Hoyer 1984). Product information for frequently purchased consumer goods, also, is usually acquired through experience, rather than through extensive external information search. Hence, the more experience a consumer has with a wider set of choice alternatives, the easier it will be to find a suitable alternative for the OOS item, as s/he can rely on previously developed choice heuristics and internal product information. Research on brand switching behavior has pointed to two major reasons for switching among various items of a product category: a desire for variety, and sales promotions (see e.g. Mazursky et al. 1987, Van Trijp et al. 1996, Bell et al. 1998). Based on this finding,

we expect that consumers with a high *variety seeking tendency* ($VST_{h,c}$) and/or high promotion sensitivity ('*deal-proneness*', $DP_{h,c}$) have more product experience and hence, lower transaction costs of item switching:

$$TC^{I}_{h,t,c} = \beta^{I}_{0} - \beta^{I}_{1} VST_{h,c} - \beta^{I}_{2} DP_{h,c} \qquad (10)$$

Substitution costs of package size switching depend on the size consumers normally purchase. For consumers who usually buy *large packages* ($Dlarge_{h,c}$=1), the switch to a smaller size will have no or a limited effect on purchase utility, as intrinsic product characteristics are the same for large and small package sizes. In contrast, for consumers who usually buy *small packages* ($Dlarge_{h,c}$=0), the switch to a larger size may entail a higher risk of product quality deterioration. **Transaction costs of package size switching** also differ between large and small pack buyers. For small pack buyers, purchasing a larger size leads to increased storage costs, which are likely to outweigh increased handling costs associated with a switch from a large to a smaller package size. We therefore expect overall package switching costs to be asymmetric, the costs of switching away from a small pack being higher than vice versa. We therefore have:

$$C^{PS}_{h,t,c} = \gamma^{PS}_{0} - \gamma^{PS}_{1} Dlarge_{h,c} \qquad (11)$$

In a similar way as item switching costs, **store substitution costs** depend on the difference in intrinsic utility between the visited and alternative store, and on the consumer's 'attitude towards change (variety seeking tendency with respect to store choice behavior: VST_h). As indicated in the previous sections, switching to another store in response to an unexpected OOS may result in both a lower fixed and variable shopping utility. Like the difference in intrinsic utility between the first and second preference item, difference in fixed shopping utility is expected to depend on the *availability of acceptable alternative stores* ($AAAS_h$) and the degree of *store loyalty* ($SLOY_h$) (Walter and Grabner 1975, Schary and Christopher 1979, Emmelhainz et al. 1991, Corstjens and Corstjens 1995). In case planned purchases in other categories than the OOS product are also made in the alternative store, the store switch may yield a lower variable shopping utility. Following the store choice literature mentioned above, this loss in variable shopping

utility will increase with the number of items on the consumer's shopping list: it will typically be higher for *major shopping trips* ($Major_{h,t}$) undertaken to replenish the household inventory of a large number of products, than for minor or fill-in trips made to purchase a smaller number of urgently needed products (see Kahn and Schmittlein 1992, Corstjens and Costjens 1995). According to Schary and Christopher (1979) and Corstjens and Corstjens (1995), store substitution costs are also typically higher for consumers who predominantly buy *private label products* ($PL_{h,c}$). These consumers cannot find the 'exact' product counterpart in stores of a different chain, and hence will experience a larger loss in variable shopping utility. This leads to:

$$SC^{S}_{h,t,c} = \delta^{S}_{0} - \delta^{S}_{1}\ VST_{h} - \delta^{S}_{2}\ AAAS_{h} + \delta^{S}_{3}\ SLOY_{h} + \delta^{S}_{4}\ Major_{h,t} + \delta^{S}_{5}\ PL_{h,c} \qquad (12)$$

Transaction costs of store switching are made up of additional transportation costs for traveling to another store, and of additional search costs, including the cost associated with increased shopping trip duration. In line with Corstjens and Corstjens (1995), we assume that transportation costs vary directly with the *distance* between the two stores (DISTS), and also depend on the consumers' *mobility* (MOB_{h}). Like item switching, search costs associated with the mental effort needed to find an acceptable alternative store will be lower for consumers who have more experience with different stores for the given product categories. Hence, they are expected to be lower for non-loyal shoppers than for *store loyals* ($SLOY_{h}$). In addition to the mental effort needed to search for an alternative store, search costs consist of the 'disutility' of increased shopping trip duration. Within the utility maximizing framework, time is a scarce resource, and the additional time spent shopping is taken away from other, possibly more preferred activities. The extent to which additional shopping time is perceived as a cost, will depend on *time availability on the specific shopping occasion* (situation specific time constraint: $TCONS_{h,t}$) (Beatty and Ferrell 1998). Moreover, the time lost by going to another store may also be valued more highly, i.e. come at a higher cost, by consumers who have little leisure *time in general* (general time constraint: $TCONS_{h}$; East et al. 1997). As shopping competes with other activities for valuable and scarce leisure time, the perceived cost of additional shopping time will also depend on the attractiveness of

shopping relative to alternative activities. We therefore expect perceived store search costs to be substantially lower for consumers with a positive *attitude towards shopping* ($SHOPAT_h$) (Spiggle and Sewall 1987, Babin et al. 1994, East et al. 1997). This leads to the following expression:

$$TC^S_{h,t,c} = \eta^S_0 + \eta^S_1 DISTS - \eta^S_2 MOB_h + \eta^S_3 SLOY_h + \eta^S_4 TCONS_{h,t} + \eta^S_5 TCONS_h - \eta^S_6 SHOPAT_h \quad (13)$$

Similar variables affect the potential future **transaction costs of purchase deferment** – i.e. the costs of shopping trip acceleration – which are associated with the additional time and effort needed to re-visit the store earlier than planned[iv]. For reasons outlined above, effort cost of shopping trip acceleration is expected to decrease with consumer *mobility* (MOB_h), and to be lower for buyers who live near the store, and hence, have to cover a smaller *distance* ($DISTH_h$) to revisit it. Next, like for store switching, we expect perceived time costs to depend on the consumer's *time available* for shopping ($TCONS_h$) and on his/her *attitude towards shopping* ($SHOPAT_h$). However, in contrast to an immediate store switch, an extra future store visit can be planned in advance. Consumers engaging in *frequent store visits* ($FREQ_h$) have more flexibility in rearranging the timing of their store visits without disrupting their future pantry replenishment pattern. Hence, frequent shoppers may be expected to experience lower costs of shopping trip acceleration. This expectation is in line with observations made by Kim and Park (1997), who typify frequent shoppers as more 'opportunistic'. In a similar vein, Bell and Lattin (1998) state that 'small basket shoppers' - who visit stores much more frequently - defer their purchases when conditions in the store are less favorable. We therefore obtain:

$$TC^D_{h,t,c} = \theta^D_0 - \theta^D_1 MOB_h + \theta^D_2 DISTH_h + \theta^D_3 TCONS_h - \theta^D_4 SHOPAT_h - \theta^D_5 FREQ_h \quad (14)$$

Opportunity costs associated with purchase deferment increase with the risk of running short of the product before the next shopping trip. Such a shortage is more likely to occur when the number of units in stock is only slightly above or equal to the expected consumption rate. In the case of purchase cancellation, the consumer is sure to run short of the product. Here also, the expected amount of lost consumption depends on the

'*required purchase quantity* to avoid shortages at home' ($RPQ_{h,t,c}$); i.e., the difference between expected consumption needs till the next regular store visit, and current household inventory. The impact of inventory level and product need on a consumer's decision to buy is confirmed by Sivakumar and Raj (1997), and Kumar, Karande and Reinartz (1998), and was already referred to by C& C in the context of stock-outs.

Besides 'expected' needs based on average consumption patterns, consumers may anticipate higher than usual product needs due to special occasions or other exceptional situations. Following the shopping behavior literature, these exceptional or above-average product needs are a typical reason to engage in 'fill in' or 'minor' shopping trips (see e.g. Kahn and Schmittlein 1992). Opportunity costs of purchase deferment can therefore be expected to be higher on minor than on major shopping trips ($Major_{h,t,c}$).

In addition to the amount of lost consumption, perceived costs of a (potential) shortage depends on product utility, i.e. on the *importance* the consumer attaches to the product ($IMP_{h,c}$). We thus have:

$$OC^{D}_{h,t,c} = \xi^{D}_{0} + \xi^{D}_{1}\, RPQ_{h,t,c} - \xi^{D}_{2}\, Major_{h,t,c} + \xi^{D}_{3}\, IMP_{h,c} \qquad (15)$$

$$OC^{C}_{h,t,c} = \lambda^{C}_{0} + \lambda^{C}_{1}\, RPQ_{h,t,c} - \lambda^{C}_{2}\, Major_{h,t,c} + \lambda^{C}_{3}\, IMP_{h,c} \qquad (16)$$

Equations (1) to (16) summarize the expected influences of consumer, product and situational factors on the various cost and risk components associated with OOS reactions. This 'pattern' of effects allows us to formulate, for some of these factors, hypotheses on how they affect specific OOS reactions[v]:

H1: The probability that a consumer will switch to another item in response to an OOS for his/her favorite or regular item
(a) decreases with higher levels of item loyalty,
(b) is higher for deal-prone consumers,
(c) is higher when acceptable alternatives are available.

H2: The probability that a consumer will switch to another package size in response to an OOS for his/her favorite or regular size is larger for consumers who normally buy large packages than for small size buyers.

H3: The probability that a consumer will switch to another store in response to an OOS for his/her favorite or regular item

(a) decreases with the consumer's degree of store loyalty,
(b) is lower for buyers who purchase private label products,
(c) is lower for buyers faced with higher time constraints at the time of purchase,
(d) is lower on major than on minor shopping trips.

H4: The probability that a consumer will defer a planned purchase when his/her favorite or regular item is OOS
(a) is higher for buyers who live near the store,
(b) is higher for consumers with a high shopping frequency.

As can be seen from the framework, some factors affect various cost and risk components simultaneously. For those factors, it is difficult to predict which specific OOS reaction will become more likely. Nevertheless, expectations can be formed on the likelihood of groups of OOS reactions versus others:

H5: The probability that a consumer will switch to another store or defer a planned purchase in response to an OOS for his/her favorite or regular item
(a) is higher for shoppers who are more mobile,
(b) is higher for consumers with a positive attitude towards shopping.
(c) is lower for consumers with higher general time constraints.

H6: The probability that a consumer will defer or drop a planned purchase when the favorite or regular item is OOS
(a) is higher at major than at minor shopping trips,
(b) is lower when a larger purchase quantity is required,
(c) is lower when the importance attached to the product is higher.

As indicated in the literature review, some of these relationships have been postulated – though not necessarily empirically tested – in previous OOS studies. This is true for item loyalty (H1a), availability of acceptable alternative items (H1c), store loyalty (H3a), private label buying (H3b), shopping trip type (H3d and H6a), and mobility (H5a). Our analysis integrates these insights and extends previous OOS research by examining several additional factors and relationships: deal-proneness (H1b), package size (H2), time constraints (H3c and H5c), store distance (H4a), shopping frequency (H4b), shopping attitude (H5b), required purchase quantity (H6b) and product importance (H6c).

DATA AND MEASURES

Setting

Data on OOS responses and determinants were collected by means of a questionnaire, a data collection procedure that has been used by several other researchers analyzing OOS reactions (e.g. Peckham 1963, Walter and Grabner 1975, Schary and Christopher 1979, Zinszer and Lesser 1981, Emmelhainz et al. 1991). A major advantage of questionnaires over behavioral data is that a direct measure of all reactions to an OOS can be obtained, enabling to clearly distinguish between store switching, purchase deferment and cancellation. Second, surveys offer the opportunity to collect additional information on factors like the availability of acceptable substitutes and situation-specific time constraints.

The survey measured the reaction to a hypothetical rather than to an actual OOS. This approach has advantages and disadvantages. On the positive side, it allows to keep the number of interviews at a tractable level, while generating a large number of observations over a limited time span. Also, it ensures sufficient 'variation' in the items for which an OOS reaction is measured. As observed by Peckham (1963), retailers maximally avoid OOS for items enjoying high brand loyalty. Using true stock-outs as a basis for analysis therefore entails a potential bias in the type of items studied, which can be avoided by using responses to a fictitious OOS. A drawback of our approach is that we record intended rather than true (revealed) OOS responses. Also, the responses only pertain to situations where consumers have the intention to purchase from the category, look for a favorite item, and notice the stock-out. If purchases in the category occur impulsively or are not based on preferences, the line of questioning adopted here might be less realistic. Yet, the responses reveal that in our data set, almost all purchases were 'planned' or 'reminder' purchases, and not impulse purchases (Beatty and Ferrell 1998), which was expected for the categories considered in this study.

Respondents were intercepted and interviewed in one store of a large supermarket chain, the product assortment of which served as a starting point for questionnaire development. Data were collected for two product categories: breakfast cereals and margarine. While these categories differ on some determinants of OOS reactions - previous research demonstrated, for instance, that the degree of variety seeking is larger for cereals than for margarine – they are fairly similar in other respects. Both categories come in a deep assortment, comprising a wide range of brands and varieties. For cereals, the store's shelves offer a total of 31 SKU's, from 3 national brands, as well as a distributor and a generic brand. The three brand types are also present in the margarine category, where 8 national brands are present, and a total of 18 SKU's are encountered in the store's assortment. Both categories are high rotation categories, which are fairly regularly 'plagued' by stock-outs. Probing consumers about their reactions in case of a stock-out is therefore realistic for margarine as well as cereals. In total, 449 questionnaires were administered for cereals, and 544 for margarine.

Independent Variables

The questionnaire consisted of two parts. Questions in the first part collected information on previously discussed determinants of OOS reactions. Table 3 provides a description of the measurement instruments used. *Item loyalty, Deal proneness, Availability of Acceptable Alternatives, Store Loyalty, and Shopping Attitude* were measured by means of self-report scales of the Likert type. To keep interview time within reasonable limits and avoid respondent fatigue, we adopted streamlined versions of existing multiple item scales, from which statements were selected so as to capture the basic scale dimensions. The selected items had shown satisfactory reliability in previous research, and these reliabilities were supported in our study. Appendix 1 summarizes the measures used to quantify these cost determinants, and reports associated reliabilities (Pearson correlation

Table 3
Determinants of OOS and their measurement

OOS Determinant	*Concept*	*Measure*
Product-specific Characteristics		
Item Loyalty	Tendency to stay with favorite item rather than seek variation	Self-report Scale (based on Baumgartner and Steenkamp 1996)
Deal Proneness	Attitude towards and tendency to use promotions in category. Used as indicator of category familiarity.	Self-Report Scale (based on Lichtenstein et al. 1997)
Private Label buyer	Regular brand type	Dummy variable, equal to 1 if the consumer regularly buys the generic product, equal to 0 otherwise
Availability of Acceptable Alternatives	Perceived differentiation among category items , Perceived risk of switching to another alternative	Self-Report Scale (based on Jain and Srinivasan 1990)
Availability of Other Package Size	Objective registration of whether the same brand and variety is offered in another size	Dummy variable, equal to 1 if other size available, equal to 0 otherwise.
Product Importance	Safety Stock (number of units household generally keeps in store for emergencies) used as indicator of product importance.	Number of units at home when new purchase is decided upon.
Regular Package Size		Dummy variable, equal to 1 if consumer normally buys large pack, 0 otherwise.
General Consumer Characteristics		
Store Loyalty General Specific	 Tendency to concentrate purchases in one store Loyalty to survey outlet	 Self Report Scale (based on Baumgartner and Steenkamp 1996) % of shopping trips made at survey store
Shopping Frequency	Average shopping frequency	Average number of shopping trips/ week
General Time Constraint	Time Pressure from respondents' employment Extra time pressure in double income families	Respondent's employment level (% of Full time) and, if applicable, partner's employment level
Shopping Attitude	Perception of shopping as a necessary task, or something to be enjoyed	Self Report Scale (based on Babin et al. 1994)
Store Distance	Travel Time	Number of minutes needed to reach store
Mobility	Regular transportation mode used for shopping	Car=1, other=0
Situation-Specific Characteristics		
Required Purchase Quantity	Number of units respondent has to purchase to prevent out of stock at home before next regular shopping trip.	Difference between expected consumption rate and home inventory level at start of shopping trip (based on average weekly consumption and inter-purchase time).
Situation-specific time constraint	Measurement of available time on the OOS shopping trip	Degree of 'hurriedness' on 5 point scale
Type of Shopping Trip	Distinction between major and minor shopping trips	Dummy variable, equal to 1 for major , and equal to 0 for minor shopping trips

for 2 items, Chronbach alpha for 3 items). A principal component analysis including all items from the questionnaire, showed a clear distinction between the different constructs or scales. It associated a separate factor with each scale, where items intended to measure that scale had high loadings, and others did not. This provides further support for the reliability and discriminant validity of our scales.

Where a clear distinction can be made between item loyalty and variety seeking/avoidance at the conceptual level, the tendency to repurchase the item out of commitment, or to avoid switching because of a reluctance to change, are difficult to distinguish at the behavioral level. Rather than incorporating two separate scales that would yield highly (negatively) correlated scores, we therefore assessed the two related constructs by a single scale. A similar procedure was followed by other authors examining dynamic buying behavior (see e.g. Givon 1984, Van Trijp et al. 1996). Low scores on the scale are associated with highly disloyal or variety seeking behavior, while high scores indicate extreme loyal or variety avoidance behavior. A similar scale was used to measure loyalty and variety seeking with respect to store choice. In addition, we included a store-specific behavioral measure of store loyalty - the percentage of grocery shopping allocated to the store - capturing the extent to which the interview store constitutes the most preferred store.

For a number of the remaining characteristics, indicator variables were used. For instance, the consumer's regular safety stock - the number of units below which consumers do not knowingly wish to let their home inventory drop - was used as a proxy for *Product Importance*. Compared to more general measures of product importance such as involvement scales, safety stock gives a direct indication of how important it is to the consumer not to fall short of the product. Note that our measure of product importance refers to 'regular' or 'typical' safety stocks reported by consumers, and not the specific number of units available at home at the time of the survey. In line with previous studies, information on the degree of employment of the respondent and, if relevant, his/her partner, was used as an indicator of *his/her general time constraint* (Kim and Park 1997).

The regular transportation mode used for shopping is registered to assess consumer *mobility* (see e.g. Messinger and Narasimhan 1997), and *store distance* is measured as reported travel time to the store. Information was also collected on the *type of shopping trip*, by asking respondents whether they visited the store to replenish the inventory of various product categories (major shopping trip), or whether they only needed a limited number of products (minor shopping trip).

Dependent Variable

In the second part of the questionnaire, we measured consumer response to a fictitious OOS. Note that throughout the interview period, no actual OOS for cereals or margarine were observed in the store. Respondents who had actually made a purchase in one of the relevant categories, were asked whether the purchase was planned, and what their reaction would have been had this product not been available on the store shelf. To enhance the realism of choice decisions, consumers could consult a sheet with item pictures reproducing the store's shelf layout in the category. Respondents who didn't buy any cereals or margarine on that shopping occasion, were asked to indicate their favorite or most often bought item from each category, making use of the shelf sheet. Next, they were probed about how they would react if they had planned to buy the product and it would have been unavailable[vi]. For margarine, consumers could choose between the 5 'stylized' response categories used in earlier OOS studies. For cereals, the option to switch to another package size was not included, as all SKU brands and varieties are offered in one package size only. The cereals assortment comprises 29 items sold in large packs only (375 or 500 gr.), and two smaller sized variety packs (200 gr).

Preliminary Outcomes

Table 4 reports the frequencies with which each of the OOS reactions were observed. In the cereals category, the decisions to defer the purchase and to switch to another item clearly dominate alternative OOS responses, and are approximately equally important. Differences in reaction are more pronounced for margarine, where the majority of

respondents prefers to switch to another item. A smaller, but still non-negligible group of respondents indicates to postpone the purchase. Switching to another package size of the same brand and type comes third, while switching stores and purchase cancellation are much less often observed.

Table 4
Survey results, frequency distribution of OOS responses

OOS response	Proportion cereals	Proportion margarine
switch size		15 %
switch item	44 %	51 %
switch store	3.3 %	2 %
defer purchase	49 %	30 %
drop purchase	3.7 %	2 %

Comparing the results obtained here with those of previous studies, we find a similar proportion of buyers who switch to another package size, brand or variety. Very few consumers intend to drop their purchase - an observation that may be typical of frequently consumed categories like cereals and margarine. The percentage of consumers who indicate they would defer their purchase is higher than that obtained in other studies, while a smaller portion of cases points to store switching. A possible reason behind this finding may be that the store carries a deep assortment in both categories (see Broniarczyk et al. 1998, for similar findings in the context of assortment reduction). The implication is that the 'absolute' distribution of OOS responses should be treated with caution - an observation that equally holds for other OOS studies with their specific settings and methodologies. Yet, given our interest in assessing the *impact* of consumer, product, and situation characteristics on OOS responses, rather than in extrapolating the distributions as such, this by no means affects the validity of our analysis.

EMPIRICAL ANALYSIS AND HYPOTHESIS TESTS

Methodology

To test the hypotheses, we start out with the general formulation in equations (1)-(3). Rather than imposing a priori constraints regarding the impact of explanatory variables on the utility of specific stock-out reactions, we included all explanatory variables in each

option's utility function. This approach has the advantage of 'letting the data speak for themselves'. In estimating the MNL model, we should recognize that none of the explanatory variables vary with the decision options. The purpose of the model is to estimate how a given set of household, category and situation characteristics differentially influence the choice probabilities for different options. Stated otherwise: not the explanatory variables, but the parameters associated with these variables, are option-specific. An inherent feature of this type of MNL model is that it does not allow to estimate absolute, but only relative parameter levels (Maddala 1990, Van Trijp et al. 1996). If a given characteristic has completely similar utility implications - the same absolute parameter levels - for all OOS reactions, it would clearly 'cancel out' and disappear from equation (3). In contrast, a characteristic that leads to a significant increase in some choice utilities but not in others will not cancel out, and contribute to the explanation of OOS reactions. It follows that in the estimation stage, the parameters in the utility expression for one choice option have to be set equal to zero, and parameters for other choice options are then estimated relative to this reference option (Maddala 1990).

The parameters and their significance should then be interpreted as follows. If, in a given choice option, the parameter associated with an explanatory variable is significant, this means that its impact is significantly different from that on the reference option. Also, as soon as a variable has at least one significant coefficient, it does 'not cancel out' and hence 'significantly contributes to explaining OOS response'. We will therefore use the t-tests on the estimated MNL parameters to assess whether or not a variable is a significant determinant of OOS response.

Clearly, however, our hypotheses involve statements on how explanatory variables affect specific choice options and not just on whether they influence the reaction to stock-outs in general. As estimated parameters have only a relative meaning, they do not reveal whether a variable increases or decreases the likelihood of a choice option. The impact of a variable on a specific choice option should be assessed by calculating its marginal effect

or first order derivative - given the estimated parameters- on that option's probability in the left hand side of equation (3) (see, e.g., Ben Akiva and Lerman 1985).

Estimation Results

For both product categories, parameters of the choice utilities are estimated taking the decision to defer the purchase as the reference choice[vii]. Collinearity diagnostics revealed there were no collinearity problems in the data set. Table 5 reports goodness of fit results for the MNL estimation. To get an impression of the relative importance of product, consumer and situation characteristics in explaining stock-out response, four models are estimated per product category. The base models C1 and M1 include choice-specific constants only, and serve as a reference model for cereals and margarine, respectively.

Table 5
Goodness of fit for various model versions

	Log Likelihood	**Number of parameters**	U^2 (compared to base model C1 and M1)
Base Models			
C1	-426	3	-
M1	-628	4	-
Product characteristics			
C2	-394[a]	15	.076
M2	-600[a]	28	.046
Product and Consumer characteristics			
C3			
M3	-372[a]	39	.127
	-574[c]	60	.086
Product, Consumer and Situation characteristics			
C4	-362[b]	51	.152
M4	-562[a]	76	.105

number of observations: margarine: 449, cereals: 544

[a] significant improvement over preceding model (M2⇔M3, M3⇔M4, C2⇔C3, C3⇔C4) using a Likelihood-ratio test and 5% significance level,

[b] idem at 10% significance level

[c] idem at 15% significance level

Models C2 and M2 incorporate (perceived) product-related variables from equations (9) to (16), models C3 and M3 add consumer characteristics to the set of explanatory variables. Models C4 and M4, finally, are the 'full' models, containing all product,

consumer and situational factors in equations (9) to (16). Each type of variable contributes to model fit, as can be judged from the U^2 values and associated likelihood-ratio tests (Ben-Akiva and Lerman, 1985). In the remainder of the discussion, we concentrate on the results for the full models.

To measure the brand type effect, we incorporate a dummy variable for the generic product only, because this yielded substantially better results than (i) a model with a distributor brand variable only and (ii) a model with both distributor and generic dummy variables. The fact that national brands and private label brands (other than generics) trigger similar OOS responses may be explained by the decreasing quality gap between both brand types referred to by Bronnenberg and Wathieu (1996). Generics, in contrast, remain positioned as a much cheaper low quality alternative, and show up in our estimation results as a separate brand type. As there is only one – rarely purchased - generic item in the cereals category, no brand type variable is incorporated for cereals.

Table 6
Marginal Impact of explanatory variables on OOS reaction probabilities: Cereals[a]

Factors	Switch Item	Switch Store	Cancel	Defer
Product characteristics				
Item Loyalty	**-.0297**	**.0039**	**-.0015**	**.0273**
Deal-proneness	.0053	-.0014	.0010	-.0048
Acceptable alternatives	**.0432**	**-.0069**	**-.0044**	**-.0320**
Regular Pack Large	**.0878**	**-.0082**	**-.0287**	**-.0509**
Product Importance	-.0386	.0090	-.0129	.0424
Consumer characteristics				
Store Loyalty				
General	**.0037**	**-.0054**	**.0006**	**.0012**
Specific	**-.1078**	**-.0469**	**.0046**	**.1501**
Shopping Frequency	.0297	-.0210	.0144	-.0230
Shopping Attitude	**-.0235**	**.0004**	**-.0054**	**.0285**
General Time Constraint				
% Employment	**-.0013**	**-.0012**	**.0133**	**-.0109**
% Employment partner	**.0043**	**.0316**	**.0054**	**-.0413**
Store Distance	**.0083**	**.0017**	**-.0238**	**.0139**
Situation characteristics				
Mobility	-.0469	.0066	-.0130	.0534
Time Constraint at shop.trip	**.0338**	**-.0204**	**.0021**	**-.0154**
Required purchase quantity	**.0663**	**-.0076**	**.0077**	**-.0663**
Major Shopping Trip	**.0173**	**.0099**	**.0303**	**-.0576**

[a] Derivatives of variables with at least one significant coefficient are printed in bold

Table 7
Marginal Impact of explanatory variables on OOS reaction probabilities: margarine[a]

Factors	Switch Size	Switch Item	Switch Store	Cancel	Defer
Product characteristics					
Item Loyalty	**.0067**	**-.027**	**.0014**	**-.003**	**.0223**
Deal-proneness	-.0038	-.0016	.0023	.0008	.0023
Acceptable alternatives	**.003**	**.037**	**-.006**	**0**	**-.034**
Regular Pack Large	**.0877**	**.0049**	**-.0065**	**.0081**	**-.0941**
Private Label	**-.024**	**-.1554**	**.0069**	**-.0078**	**.1803**
Product Importance	**-.0193**	**.0018**	**-.0060**	**-.0252**	**.0488**
Other size available	**.096**	**-0.075**	**-0.0039**	**-0.0056**	**-0.0123**
Consumer characteristics					
Store Loyalty					
General	**-.014**	**-.0052**	**-.0026**	**-.0038**	**.0174**
Specific	**-.0345**	**.0191**	**-.0486**	**-.0054**	**.0694**
Shopping Frequency	**.0375**	**-.069**	**.0217**	**-.0614**	**.0719**
Shopping Attitude	**.0075**	**.0082**	**-.0028**	**-.0067**	**-.0062**
General Time Constraint					
% Employment	**.032**	**-.005**	**-.007**	**-.0065**	**-.013**
% Employment partner	-.01	.015	-.002	.0023	-.0055
Store Distance	.0094	-.0041	-.0070	-.0007	.0024
Situation characteristics					
Mobility	.062	-.107	.0280	-.013	.030
Time Constraint at shop.trip	**-.036**	**.0220**	**-.002**	**.0047**	**.0119**
Required purchase quantity	**.0149**	**.0436**	**-.0044**	**-.0082**	**-.0459**
Major Shopping Trip	**-.0575**	**.0462**	**-.0017**	**.0368**	**-.0238**

[a] Derivatives of variables with at least one significant coefficient are printed in bold

Estimation results reveal that most variables have at least one coefficient significantly different from zero in both categories. As argued in the Methodology section, this indicates that these variables significantly contribute to the explanation of stock-out response. Only for the mobility and deal-proneness variables, none of the coefficients is significant, and this for margarine nor for cereals. The interpretation is that these variables affect the utilities of all stock-out responses in a similar fashion, and hence cancel out in the MNL model.

As indicated above, we use first order derivatives to verify whether (significant) explanatory variables cause a change in OOS response probability in the expected direction. Tables 6 and 7 report these first order derivatives for all explanatory variables and choice options, for cereals and margarine, respectively. To facilitate interpretation,

derivatives associated with variables whose impact on OOS response was found significant, are indicated in bold. We discuss each hypothesis in turn.

Hypothesis 1: Tables 6 and 7 reveal that in each category, item loyalty has a significant negative impact on the probability of item switching, while the availability of acceptable alternatives has a significant positive effect. In both categories, we therefore find strong support for hypotheses H1a and H1c. Hypothesis H1b, in contrast, is not confirmed. Deal-proneness has no significant effect on item switching probability, for cereals nor for margarine. This lack of impact may indicate that deal proneness is a bad indicator of search costs, or that individual differences in experience between consumers are completely captured by the item loyalty variable. Alternatively, search costs may be low or negligible for all buyers, as most consumers buy the analyzed products very frequently and can thus be expected to be quite familiar with the product category.

Hypothesis 2: Table 7 points to a significant positive influence for the 'large regular pack' variable on the probability to switch size. For margarine, hypothesis H2 that large pack buyers more easily switch to another size when their preferred item is unavailable, is therefore accepted. In the cereals category, all items are offered in one package size only so that the option to switch to another size is not available. Even so, regular package size has a significant effect on the OOS response probabilities in this category: table 6 indicates that buyers who normally adopt large packages more easily switch to another item than consumers who buy the smaller sized variety packs. Rather than confirming hypothesis H2 which relates to size switching only, this result provides further support for hypothesis H1c, as the number of available alternatives of the same size is much larger for the large than for the small package items (29 compared to 2 items).

Hypothesis 3: From tables 6 and 7, we conclude that both the general and store-specific loyalty variables have a significant and negative effect on the probability of store switching, and this in the cereals as well as the margarine category. A significant and negative effect on store switching is also found for the time constraint at the shopping

trip. Hypotheses H3a and H3c are thus confirmed. The generic product variable in the margarine category has an unexpected positive effect on store switch probability: hypothesis H3b is not supported. The fact that generic buyers are willing to go through more effort than national brand or private label buyers to purchase their generic product may be an indicator of what Bronnenberg and Wathieu (1996) refer to as an 'reverted asymmetric effect', caused by the favorable price/quality position of these brands. The substantially higher price of national and private label substitutes may not be compensated by their perceived quality superiority, such that price-sensitive buyers of generic products may prefer to go to another store rather than buy an item from a higher price tier. Hypothesis H3d, finally, is confirmed for margarine – where we find the probability of store switching to be significantly lower on major than on minor shopping trips -but is not confirmed for cereals.

Hypothesis 4: Mixed results are obtained for the impact of store distance and shopping frequency on the probability to defer the purchase. While store distance does not significantly affect OOS reactions for margarine, it surprisingly increases the likelihood of purchase postponement for cereals. H4a is therefore not supported by the data. A tentative explanation is that, once transportation mode is accounted for, distance differences are no longer sufficiently relevant or important to explain differences in OOS response. For shopping frequency, no significant impact is found on OOS response for cereals, while its marginal effect on the probability of purchase deferment for margarine is significant and positive. H4b is thus only partially supported: it is confirmed for margarine, but nor for cereals.

Hypothesis 5: While, as hypothesised, the marginal impact of 'buyer mobility' on the probability to switch stores or defer the purchase is positive in both categories, it is not significant. H5a is therefore not supported by the data. One explanation is that our measure, transportation mode, is not a good indicator of buyer mobility. Another explanation lies in the potentially positive link between car ownership and store loyalty. Possessing a car enables consumers to shop efficiently and engage in one stop shopping

(East et al. 1997 and Messinger and Narasimhan 1998). Instead of being completely captured in the store loyalty parameter, this effect may still partly show up in our data set as a direct (negative) effect of car ownership on the switch store or defer purchase probability, which counteracts against the 'pure' mobility effect of car possession. The consumers' shopping attitude has mixed effects on OOS responses. Hypothesis H5b is confirmed for cereals, where we find a significant and positive impact on both the probability of store switching and postponement, but it is not for margarine, where a significant but negative effect is observed. Hypothesis H5c is largely confirmed by the data: in both categories, the respondent's employment rate significantly and negatively affects the switch store and defer probabilities. Employment of the partner does not produce a negative store switching effect for cereals or margarine. Yet, as the large majority of the respondents are females, this finding is not too surprising: female employment rather than male employment was found in the literature to be a good indicator of the household's opportunity cost of time. Overall, the negative impact of employment rate on likelihood to postpone suggests that consumers who defer the purchase indeed consider accelerating the next purchase.

Hypothesis 6: In tables 6 and 7, major shopping trips lead to a significant increase in the probability to cancel the purchase, which is in line with hypothesis H6a. Yet, contrary to expectations, it reduces the likelihood of postponement. For cereals, the latter negative effect on postponement outweighs the positive impact for the cancel option, implying that H6a cannot be accepted for this category. The tables further indicate that buyers are more likely to either postpone or cancel the purchase when the required purchase quantity is small, thereby confirming hypothesis H6b. Product importance, finally, does not have a significant impact on OOS responses for cereals. In the margarine category, it has a significant and negative impact on the likelihood of purchase cancellation. Yet, this impact is more than offset by the positive effect on the likelihood to defer. H6c is therefore not supported by the data. When interpreting these results, we have to keep in mind the small number of observations for the defer and cancel options, and the possible confusion between defer and cancel. In reality, consumers may buy a smaller than

planned quantity of an alternative item to meet most urgent needs, in which case only a limited amount of consumption is given up. This change in purchase quantity decision is only partially accounted for by the defer and cancel options, and may have caused confusion between both options.

Overall, we find support for the majority of the hypotheses related to item and package size switching (Hypotheses 1 and 2): 3 out of 4 explanatory variables have a significant effect on the switching probabilities in the expected direction. Partial support is obtained for the hypotheses related to store switching (Hypotheses 3 and 5), and weak support for the hypotheses related to purchase deferment and cancellation (Hypotheses 4, 5 and 6).

Discussion

From the foregoing analysis, some key implications can be derived, which are summarized below.

"OOS reactions are affected by consumer, category- and situational factors"

The results reveal that OOS response of a consumer is not independent across categories, but is at least partially explained by general consumer traits and characteristics. At the same time, perceived category characteristics and factors specific to the shopping occasion significantly shape consumer response. A full understanding of OOS response therefore requires insights into all three types of characteristics[viii]. A key implication for practitioners is that marketing strategies designed to reduce or avoid negative consequences of stock-outs should not only address specific consumer segments, but must account for category specifics as well as contextual effects.

"Loyalty matters"

The results of this study confirm that manufacturers and retailers enjoying high loyalty are much less likely to incur important losses from OOS. Item loyalty is found to have a strong impact on OOS response, and leads to substantially less item switching. In a

similar vein, store loyalty significantly reduces the probability of store switching in response to OOS. Also, the availability of acceptable alternatives leads to major switches between category items within the store. It follows that for any brand or store, identifying the number of loyal customers and their use rates in the category is essential in predicting the magnitude of losses or sales shifts resulting from OOS. Moreover, to keep undesirable OOS implications low, manufacturers should invest in brand loyalty, and retailers in building store equity. The results further indicate that manufacturers are much more vulnerable to OOS in outlets where the 'competitive assortment' in the category is attractive. Manufacturers should therefore pay specific attention to those outlets in terms of replenishment, through the use of category management, or by ensuring retailer co-operation using trade promotion incentives. The importance of acceptable alternatives does suggest that, for manufacturers, offering a sufficiently deep line within the store may circumvent stock-out losses. For retailers, the characteristics of the category assortment are equally crucial to keep customers in the store in case of disruptions for some items.

"Double Jeopardy in OOS reactions"

Our results underscore the 'risks' involved in OOS, and suggest that OOS reactions involve their own type of 'double jeopardy' problem: purchase baskets that are potentially important are more likely to be lost. From the manufacturer's point of view, it is important to realize that consumers who require a large product quantity are more likely to switch to another item. Our findings also suggest that manufacturers should be particularly alert to avoiding stock-outs during peak periods. This is true not only because OOS are more likely to occur then, their implications may also be more severe, given that the type of consumers prevailing in those periods typically have little time on their hands and engage in major shopping trips. Retailers seem less at risk, as consumers engaging in a major shopping trip are more likely to purchase another item in the store than those involved in a minor shopping trip. Yet, as the cereals results demonstrate, the possibility that these consumers will switch to another store cannot be ruled out. Especially if stock-outs are encountered in several of the pursued categories simultaneously, the latter option seems to become a real threat.

"OOS response calls for separate research"

Even though some of the consumer behavior mechanisms underlying OOS response may be similar to those explaining brand switching or promotional response, our conceptual framework points to substantial differences. The empirical results further indicate that the link between reactions to promotions and stock-outs is weak: deal proneness cannot be used as a reliable indicator of OOS response. At the same time, loyalty to an item, or to a store, only partially - be it significantly - explain reactions to a stock-out. It follows that managers interested in OOS responses cannot simply infer these from other observed behaviors, and that stock-out reactions, especially in view of their damaging consequences, clearly warrant research in their own right.

"The Role of Category Differences"

The primary objective of our research was to clarify reaction differences between respondents and purchase occasions in a given category, not across categories. Yet, even if major category differences between consumers are accounted for (product-specific variables in Table 3), basic category values - common to all consumers- may interact with other variables included in the model and exert some influence on the model parameters. Our empirical results show that, while the overall pattern of effects is similar in both categories, deviations occur for some variables. These may be explained by average between-category differences as follows. Cereals are only available in one size. These assortment differences clarify why, in the cereals category, large pack buyers engage in substantially more item switching and have a lower tendency to cancel the purchase than small pack buyers. This is in contrast with margarine, where large pack buyers essentially switch sizes and are less likely to defer the purchase than small pack buyers. A priori, we also expect ability to stockpile to be lower for cereals than for margarine because of higher dollar value per unit, larger volume and higher perishability. This may explain why product importance, measured by typical safety stock levels, is significant for margarine but not for cereals: in the latter category, even consumers who find the product important have high barriers to stocking it up[ix]. In brief, while the basic premises of our

framework may be expected to hold in a wide range of categories, our findings also show that category characteristics common to all consumers could magnify or shrink the impact of our explanatory variables.

CONCLUSIONS, STUDY LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The study indicates that reactions to OOS within a given product category are significantly affected by three types of variables: product characteristics, consumer characteristics, and situational factors. More specifically, and in line with the conceptual framework, we find that whether consumers will switch to another item or size, change stores, or decide not to make a purchase in the category, depends on their 'intrinsic' item or store loyalty, the availability of acceptable alternatives, their regular brand type and package size, the time available for and attitude towards shopping, the type of shopping trip, and the strength of the product need as determined by the consumer's use rate and shopping frequency. From a managerial viewpoint, the results emphasize the potential losses involved in OOS, and suggest ways to overcome or reduce such losses. The study also shows that promotion reaction is no clear-cut indicator of OOS response; emphasizing the need to treat consumer response to OOS as a separate research issue.

Clearly, our study has a number of limitations. The analysis comprises only two product categories and one store. The study is also confined to explaining differences in OOS reactions within categories. While this seems a highly relevant objective, managers may also have an interest in looking at differences in OOS response across categories, an issue we leave for future research. Another limitation is that the model does not include interactions in the utility functions. Even though the use of linear utility functions is not uncommon, including interactions between explanatory variables might be a worthwhile undertaking. Yet, in our application, the number of observations on several choice options and the variation in certain explanatory characteristics was too limited to allow for reliable estimation of interaction effects. Also, even though these interactions are not built

in in the utility functions, it should be noted that the decision option probabilities of the MNL model synergistically depend on the explanatory variables (see e.g. Ben-Akiva and Lerman 1985). Differently stated, the MNL model structure has some built-in interactions at the level of choice probabilities, which may be less flexible, but the directions of which often correspond to expectations. An important limitation that our study shares with previous OOS analyses is that the reaction alternatives studied, while covering the majority of situations, are neither mutually exclusive nor exhaustive. In fact, our study concentrates on choice responses, but disregards the impact of stock-outs on purchase quantity. In reality, consumers may react to an OOS by purchasing a smaller quantity of a different product till their favorite item is available again, and in fact opt for a combination of item switching and purchase deference. Or they may decide to buy a smaller quantity of something else, but consume less as long as their favorite product is not available (a combination of switching and cancellation). As indicated in Blattberg and Neslin (1989) and Chiang (1995), buying a smaller quantity may be a good risk-reduction strategy. Another limitation is that the study looks at implications of one OOS only. Future research may concentrate on dynamic consequences of repeated OOS for one and the same item or category. Also, it may be particularly relevant to evaluate consumer reactions if OOS occur for different product categories simultaneously. Intuitively, one would expect reactions to such multiple stock-outs to be different from the 'sum' of isolated shortages. More research is needed on synergetic effects of multiple (simultaneous or subsequent) OOS.

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Appendix 1: Self-report scales

	Cereals	Margarine
General Store Loyalty	α-Cronbach	
	0.6764	0.7138
	Loadings[a]	
"I think of myself as a loyal customer of my supermarket."	0.783	0.786
"I would rather stay with the supermarket I usually frequent, than trying a different store I'm not very sure of."	0.810	0.810
"I like to switch between different supermarkets." [b]	0.753	0.783
Shopping attitude	Pearson correlation	
	0.6947	0.7
	Loadings[a]	
"Shopping is truly a joy."	0.915	0.908
"A good store visit is one that is over quickly." [b]	0.919	0.926
Item Loyalty	α-Cronbach	
	0.8559	0.8904
	Loadings[a]	
"I think of myself as a loyal buyer of (category)"	0.891	0.859
"I would rather stick with a brand I usually buy than try something I am not sure of."	0.899	0.866
"I like to switch between different brands of (category)." [b]	0.774	0.772
Acceptable Alternatives Availability	α-Cronbach	
	0.3986	0.4598
	Loadings[a]	
"When I would have to buy another brand of (category), I wouldn't know what brand to choose." [b]	0.162	0.082
"When choosing a brand of (category), there is little to loose by choosing poorly."	0.675	0.798
"There are few differences among (category) brands."	0.843	0.813
Deal Proneness	α-Cronbach	
	0.5628	0.5059
	Loadings[a]	
"When buying (category), I mostly pay attention to price."	0.512	0.367
"I often buy (category) on promotion."	0.844	0.787
"When I use coupons (for category), I feel that I am getting a good deal."	0.778	0.826

[a] Based on the factor loadings, each component could clearly and exclusively be associated with one of the self-report scales. For each of these scales, the table reports loadings of the associated component only.
[b] Scores of statements that measure the opposite of the indicated characteristic have been recoded.

Endnotes

[i] The need to include future periods was emphasized in Krishna et al. (1991), and Messinger and Narasimhan (1997), and follows from the fact that OOS reactions may have implications beyond the immediate consumption period.

[ii] The assumption of independent error terms across decision options can be justified by the specification of the systematic utility expression. As will be clarified below, the similarity between OOS reactions that share some benefits and/or costs is captured by the systematic part of the utility function, which incorporates these factors as explanatory variables.

[iii] Product characteristics refer to characteristics of the product category *as such*, as well as to how the consumer *perceives* that particular category. Consumer characteristics refer to 'general' consumer-related factors that are not linked to the product category.

[iv] Note that this cost is not the same as the cost of store switching, because the consumer is bound to visit his regular store (no substitution cost), yet at some point in the future. The transaction cost of the accelerated shopping trip is therefore linked to general consumer characteristics, rather than situational variables at the time the stock-out occurs.

[v] For some factors, the impact of which could not be tested in our experimental setting, no hypotheses were formulated. This is for instance the case for availability of and distance to alternative stores: as data collection takes place in one store, and store perception information is not available, these variables do not vary across respondents. In addition, no separate hypotheses were formulated for the impact of variety seeking tendency on OOS responses, the reason for which is clarified in the 'Data and Measures' section.

[vi] Before pooling the data obtained across respondents, we had a closer look at the conditions for which the stock-out response was recorded. The survey results reveal that, for consumers who actually bought an item from the category at the time of the survey, the large majority of category purchases were 'planned' and mainly occurred on a 'stock replenishment basis'. From these observations, we conclude that the responses from consumers who did buy and those who did not, could be safely 'pooled'. Also, it would be impossible to assess the impact of purchase motivation (promo or not), degree of planning, and item bought (preferred or not) on consumer OOS reaction, because too few purchases were promotion-based, unplanned, or non-preferred.

[vii] Other estimations in which alternative choice options were taken as the reference option resulted in similar conclusions on the significance of various characteristics in explaining stock-out response.

[viii] This finding bears some similarity with those of Van Trijp et al. (1996) in an analysis of purchase variation, and of Blattberg and Neslin (1990) in the context of promotion reactions. These authors observe that variety seeking behavior and deal-proneness, respectively, also systematically depend on consumer as well as product category and situational variables.

[ix] The variability in safety stock (measured by the standard deviation and/or coefficient of variation) across consumers is indeed significantly lower for cereals.