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Discussion paper

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ABSTRACT

This paper studies the effects of loyalty programs on share-of-wallet using market-wide household panel data on supermarket purchases. We find that loyalty programs relate positively to share-of-wallet, but the programs differ in effectiveness and some are ineffective. Both a saving component and a multi-vendor structure enhance the effectiveness of a loyalty program, but high discounts do not lead to higher share-of-wallets. Further, if households have multiple loyalty cards, the effectiveness of a specific loyalty program is much smaller. The positive loyalty program effects on share-of-wallet entail substantial additional customer revenues. However, given the high number of loyalty programs already available in the market, our model predicts that a new loyalty program introduction will only lead to small effects on share-of-wallet.

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Key-words: Marketing, retailing, loyalty programs, tobit-model, attraction model

INTRODUCTION

In recent years many companies have introduced loyalty programs with the goal of improving customer loyalty and revenues. Loyalty programs are currently available in many consumer markets, including supermarkets, gasoline stations, airlines, and insurance companies. Loyalty programs provide members with rewards and additional value, making them popular among consumers (Liebermann 1999). In the United States 70% of all households have at least one supermarket loyalty card (ACNielsen, Consumer insight 2000), in the Netherlands this is even 80% (GfK year guide 2000). Despite their popularity, it is not evident that loyalty programs stimulate customers' buying with a company (Dowling and Uncles 1997).

Existing empirical research on the effects of loyalty programs on buying behavior reports mixed results. Bolton, Kannan, and Bramlett (2000) studied the loyalty program of a credit card company, and found that members of the loyalty program spend more than non-members, but are not more likely to retain their accounts over time. For an insurance company, Verhoef, Franses, and Hoekstra (2001) concluded that loyalty program members are more likely to retain their insurance contracts and to purchase new insurance products at the company. But program members do not have a higher customer share, defined as number of insurance contracts with the company divided by the total number of insurance products kept (Verhoef 2001). Sharp and Sharp (1997) used panel data to measure the effects of a retail loyalty program on buying patterns at the firm level. They found minor deviations from normal loyalty patterns as measured by Dirichlet model norms. Hence, some studies report positive effects of loyalty programs, whereas others find little to no effect.

A limitation of previous studies is that they lack information on customers' memberships of competing loyalty programs. Further, most existing studies use company purchase data, and have limited or no information on buying behavior at competitors. Because consumers often buy from different companies and hold different competitive loyalty program memberships, usage of competitive information is important for a correct assessment of loyalty program effectiveness. Furthermore, each study is limited to one single loyalty program, but the effectiveness of loyalty programs may differ due to program design. Recently, futher research on the effectiveness of loyalty programs has been called for (Jain and Singh 2002). In this paper we assess the effects of loyalty programs using data from an entire market rather than just one company, and contribute to existing literature in the following three ways.

First, we account for the effects of competitive loyalty programs. Firms continuously work on improving their market position by differentiating themselves using new marketing instruments and strategies. But such differentiation is difficult to maintain in the long run, because successful ideas easily trigger competitive imitations. As a consequence, loyalty programs have become almost common property in several industries in the past decades (Lewis 1997), and consumers are members of different loyalty programs simultaneously (Passingham 1998). Competitive reactions dampen the effects of marketing efforts, as has been shown for sales promotions by Leeflang and Wittink (2001). We will extend previous research on loyalty programs by exploring to what extent competitive loyalty programs influence each other's effectiveness via multiple memberships.

Second, we study the influence of differences in loyalty program design. Under the collective term of a loyalty program, a wide range of programs operates

that differ on several dimensions. Loyalty programs differ in the degree to which they give discounts, have a saving program, and are based on cooperation with other companies. Some experimental literature exists on the effects of design elements of saving schedules (Van Osselaer and Alba 2001) and reward characteristics (Kivetz and Simonson 2002). The exact design of the loyalty program might be an important determinant of its successfulness (O'Brien and Jones 1995). To our knowledge, a study on the relation between loyalty program design and behavioral loyalty in a real market setting is lacking, and our study aims to fill part of this gap.

Finally, we examine loyalty program effects on individual-level share-of-wallet, as a measure of behavioral loyalty. Data analyzed at the aggregate level (e.g. Sharp and Sharp 1997) may mask the individual-level effects of loyalty programs. For example, differences in effectiveness between households may arise because some households have competitive loyalty program memberships. Further, share-of-wallet, being the expenditures at a specific store as a fraction of total category expenditures, is a more relevant variable than the absolute value of the expenditures in measuring loyalty (Berger et al. 2001). Only absolute expenditures are available when studying the purchase data of a single company, and have therefore been used in previous research. But expenditure levels at a single company are insufficiently informative, because they can relate to high share-of-wallet and to high category expenditures. These high category expenditures do not necessarily represent high loyalty, since they may also be due to exogenous differences between households (e.g. family size). Because it is the share of these expenditures that matters, we use share-of-wallet.

In our study we use household panel data from the Dutch supermarket industry. Seven of the twenty largest Dutch supermarket chains use loyalty programs. These programs vary in their rewarding mechanisms and cooperation with other

companies. For 1999 households, we have information on buying behavior and loyalty program memberships in all twenty supermarket chains during a two-and-a-half years period. Substantial overlap of loyalty program memberships exists, and about 50% of the households have multiple memberships. We use a Tobit-II model to assess the effects of loyalty programs on buying behavior. The Tobit-II model includes a selection equation for supermarket choice, and an attraction specification for share-of-wallet. The independent variable of key interest is loyalty program membership, but we control for relevant marketing-mix factors of supermarket chains, and socio-demographic characteristics of panel households. We find that loyalty programs relate positively to share-of-wallet, but the programs differ widely in effectiveness, and some are even ineffective. Both a saving component and a multi-vendor structure enhance the effectiveness of a loyalty program, but high discounts do not lead to higher share-of-wallets. Further, if households have multiple loyalty cards, the effectiveness of an individual loyalty program is much smaller. The positive loyalty program effects on share-of-wallet entail substantial additional customer revenues. However, given the high number of loyalty programs already available in the market, our model predicts that a new loyalty program introduction will only lead to small effects on share-of-wallet.

The remainder of the paper is structured as follows. First, we develop a conceptual framework on the relation between loyalty programs and buying behavior, and formulate several hypotheses. Second, we discuss the data of our empirical study. Then we describe the Tobit-II model used for the analysis, followed by a presentation of the results. We finish with conclusions and a discussion.

CONCEPTUAL FRAMEWORK AND HYPOTHESES

Customer loyalty

In mature markets, companies tend to shift their focus from attracting new customers to managing relations with existing customers. A central goal of customer relation management (CRM) is to improve customer loyalty. A consumer is loyal if s/he has a strong attitude to a certain supplier over its competitors (Oliver 1999, Dick and Basu 1994). Attitudinal loyalty leads to loyal buying behavior and positive word-of-mouth (Reichheld and Sasser 1990). Hence, loyalty leads to higher revenues and shields a company from competitive actions, which makes a loyal customer base a valuable asset in competitive markets (Srivastava, Shervani, and Fahey 2000).

Companies want to use the marketing-mix to improve customer loyalty. Providing good value for money enhances customer loyalty (Sirohi, McLaughlin, and Wittink 1998, Rust, Zeithaml, and Lemmon 2000). In addition, relational instruments such as loyalty programs, personal treatment, and direct mails specifically aim to improve customer loyalty in mass markets (DeWulf, Odekerken-Schröder, and Iacobucci 2001). These investments in loyalty management are especially important if consumers face low switching costs, because they are not locked in by a contract or product technique (Shapiro and Varian 2000). In many consumer markets including retailing, consumers are often regular buyers at different companies (Kahn and McAlister 1997), a phenomenon referred to as polygamous loyalty (Dowling and Uncles 1997).

In assessing the effectiveness of relational instruments, share-of-wallet plays an important role as a measure of loyal buying behavior (Berger et al. 2001). Share-of-wallet measures the percentage of total expenditures spent on purchases at a certain company. Share-of-wallet integrates choice behavior and transaction sizes during a

certain time period into one single measure, and expresses the degree to which a consumer is loyal to one supplier. Another measure widely used in measuring the effects of relational investments is purchase quantity (Bolton, Kannan, and Bramlett 2000, Verhoef, Franses, and Hoekstra 2001). A major disadvantage of this measure is that purchase quantity is the product of share-of-wallet and total category expenditures, the latter being to a large extent exogenously determined by e.g. socio-demographic characteristics. Hence, a high purchase quantity does not necessarily reflect high behavioral loyalty, and we therefore choose the share-of-wallet to be our dependent variable.

Loyalty programs

In line with previous research (e.g. Sharp and Sharp 1997, Bolton, Kannan, and Bramlett 2000), we define a loyalty program as *an integrated system of marketing actions, which aims to make member customers more loyal.* A customer must become member and identify as such at every purchase, to take advantage of the loyalty program. We expect that loyalty program members show more loyal buying behavior compared to two reference groups, namely relative to non-member customers of the same company, and relative to customers of a company without a loyalty program.

First, consumers that become members of the loyalty program are likely to identify more strongly with the company, because the membership relates them to a group of privileged customers (Bhattacharya, Rao, and Glynn 1995, Oliver 1999). Consumers identify with many groups, such as with their nation or the company they work for. In general, the identification with *commercial* organizations seems to be intensifying due to the growing centrality of consumption and materialistic desires in society (Muniz and O'Guinn 2001, Fournier 1998). Social identity research (e.g., Tajfel 1978) has shown that subjects already feel group identification if they are

randomly appointed to a group of subjects (the so-called minimal group paradigm). Since most loyalty programs use loyalty cards that members carry with them and have to show at each transaction with the company, this explicit token of membership will strengthen their sense of belonging to the company and thus enhance the identification effect. Social identity studies (Tajfel, 1978) also showed that group identification motivates members to display positive behavior towards the group (in-group favoritism). Similarly, organizational identification appears to lead to higher loyalty of employees (Smidts, Pruyn, and Riel 2001) and more loyal behavior of members of non-profit organizations (Bhattacharya 1998). Therefore, we expect that customers stronger identify with a company and become more loyal if they are members of the loyalty program.

Second, loyalty programs give rewards to members, varying from saving for items and targeted offers, to special shopping nights and preferred service treatment. The marketing activities within the loyalty program reward and stimulate customer loyalty by providing either social or economic value. For example, a members' relational magazine hardly provides economic value, but it stimulates customers' feelings of belonging and being treated special (O'Brien and Jones 1995). Economic rewards such as saving programs and discounts give specific behavioral incentives, but could make consumers calculative and create just spurious loyalty (Dick and Basu 1994). However, DeWulf, Odekerken-Schröder, and Iacobucci (2001) show for relational investments in consumer-firm relationships the existence of a reciprocity norm: customers evoke obligation towards those who treat them well or provide value. Because of these two mechanisms we expect that loyalty program members show more loyal buying behavior than both reference groups of non-members, and we hypothesize:

H_{1a}: A customer who is a loyalty program member has a higher share-of-wallet with this company than a non-program member has with this company.

H_{1b}: A customer who is a loyalty program member has a higher share-of-wallet with this company than a customer of a company without a loyalty program has with his/her company.

Loyalty Program Design

The effectiveness of a loyalty program is likely to depend on its design (Dowling and Uncles 1995, Jain and Singh 2000). We consider three key design aspects of loyalty programs that we expect to influence effectiveness: saving component, discount rate, and multi-vendor structure.

Saving component

Saving programs have received most attention in the literature, since they provide very transparent loyalty incentives. Saving programs have been studied both from an empirical observational perspective (Sharp and Sharp 1997, Bolton, Kannan, and Bramlett 2001), from an experimental perspective (Kivetz and Simonson 2002, Van Osselaer and Alba 2001), and from an industrial organizational perspective (Kopalle, Neslin and Shingh 2000, Zhang, Krishna and Dhar 2000). A saving program gives customers saving points, dependent on the monetary amount spent at the company. A program member can redeem his points for a reward, such as a free product, after s/he has reached the minimal redeeming threshold. This threshold is such that the customer must repatronage for some time. Hence, a saving component offers incentives to spend a high share-of-wallet at the company during some period of time. Though the economic value of saving points is often low, experimental research has shown that consumers overvalue saving points (Hsee 2000), and show stronger behavioral reactions to saving points than rationally expected. We therefore hypothesize:

H_{2a}: Loyalty programs without a saving component are less effective in enhancing share-of-wallet than loyalty programs with a saving component.

Price Discounts

Many loyalty programs give price discounts on promoted items. Consumers appreciate these discounts since they represent direct rewards and are linked to the core product (Liebermann 1999, Dowling and Uncles 1997). Most companies print the consumer's received discounts on the receipt, and loyalty program members may evaluate these discounts as a reward of their loyalty (Mulhern and Padgett 1995). However, price promotions have a direct negative effect on share-of-wallet because of the price reduction provided to consumers. This negative effect must at least be compensated by an increase in volume sales.

Mulhern and Padgett (1995) found that consumers who bought promoted items but did not visit the store for this reason, purchased more on their shopping trips than consumers who bought nothing on promotion. Fox, Montgomery, and Lodish (2001) found a small positive effect of promotion intensity on purchase quantities over a two years observation period. Hoch, Drèze, and Purk (1994) found from a 16-week experiment that both sales and profits increase with the number of promoted items, regardless of the pricing format of the supermarket chain. Given the results of existing literature, we expect that the positive effects of price discounts outweigh the negative effects.

H_{2b}: Higher price discounts on loyalty programs enhance share-of-wallet.

Multi-vendor structure

Some companies have a loyalty program in cooperation with companies from other industries with non-overlapping product offerings. In general, companies cooperate to exchange resources for mutual benefit, such as enhanced product value and market reputations, and access to new markets and information (Bucklin and Sengupta 1993).

If a consumer becomes a member of a multi-vendor loyalty program, s/he benefits from the program at all participating companies. E.g. at each company a consumer receives saving points, and members can potentially save credit points quicker. Because the program has a wider application than single-vendor programs, a consumer is likely to be higher involved with the program and more aware of the incentives and benefits provided. Further, participating companies can benefit from each other's reputation, especially if a consumer is loyal to one of the companies, but not yet to another. We therefore hypothesize:

H_{2c}: Multi-vendor programs are more effective in enhancing share-of-wallet than single-vendor programs.

Competitive effects

A consumer can easily be member of different loyalty programs. We expect that the effects of a loyalty program are smaller if a household also holds competitive loyalty programs memberships. Social identity theory suggests that people often retain multiple, loosely coupled identities (Ashforth and Mael 1989). But the more different companies a consumer visits in the same industry, the lower the intensity with which s/he identifies with any of these organizations (Bhattacharya, Rao, and Glynn 1995). From a rewarding perspective, the relative attractiveness of an individual loyalty program diminishes because consumers find similar incentives from different programs. We hypothesize:

H_3: The more competitive loyalty program memberships a consumer holds, the smaller the positive effect of a loyalty program on share-of-wallet.

We test the hypotheses in a research framework as represented in Figure 1. To infer unbiased loyalty program effects, we control for relevant store and household variables. We use the most important store variables in retailing: location, price, and assortment/store surface (Kahn and MacAlister 1997). Different socio-demographic

groups might appreciate these store characteristics differently, and we account for this by letting the store characteristic effects depend on household size and income.

[Insert FIGURE 1 about here]

DATA DESCRIPTION

To test the hypotheses, we conduct an empirical study on the Dutch supermarket industry. Consumers make transactions in supermarkets frequently, and face only low switching costs, which makes it an appropriate market to study loyalty programs (Shapiro and Varian 2000).

We have panel data on buying behavior of 1999 Dutch households in supermarkets during 2.5 years. The panel members provide purchase information by scanning all their supermarket receipts with a home scanner. The data cover the period July 1998 until December 2000, and have been provided by *GfK Panel Services*. We know for each household the total quarterly expenditures in each supermarket chain during these ten quarters. We use data on expenditures in the largest twenty supermarket chains; these comprise 92.8% of the entire market sales.

Seven of the twenty supermarket chains have loyalty programs, which all use loyalty cards for identification and registration. All loyalty programs but one have a saving component. Members must repatronage at least during a few months to reach a minimal redemption threshold, and exchange points for gifts or free products. Because only one loyalty program has no saving component, the influence of the saving component must be interpreted carefully. Typically, a loyalty program also provides discounts to cardholders via promoted items. Two loyalty programs are multi-vendor programs. One consists of a cooperation of a supermarket chain with a gasoline station, and the other concerns a cooperation of a supermarket chain with a wide range

of companies in different industries. This latter supermarket chain has in fact another loyalty program as well: a single-vendor discount program. Consumers can be member of either one or both of these programs. Both large and small supermarket chains have introduced loyalty programs, and some of the largest chains in the Netherlands do not have a loyalty program.

Table 1 shows the several loyalty programs with their designs, the market shares of the supermarket chains, and some customer base characteristics. The customer base of a supermarket chain consists of those households that visited the chain at least once during a certain quarter. Consumers visit on average 3.96 different supermarket chains per quarter (median = 4). On average, 78.1% of the customer base is loyalty program member, but this number varies between supermarket chains from 67.3% (Integro) till 87.7% (Jan Linders).

[Insert Table 1 about here]

Panel households fill in a yearly questionnaire in which they report on their loyalty program memberships of supermarkets. Most panel households did not change their loyalty program memberships during the observation period, but some of the households entered or quitted a loyalty program. About 88% of the panel households are member of at least one supermarket loyalty program. The duplication rate of loyalty program memberships is substantial: 33% of the panel households have two loyalty programs, 16% have three loyalty programs, and 4% have four or more loyalty programs. On average a household holds 1.65 loyalty program memberships. The questionnaires were yearly administered in January, and the information from each questionnaire is used for a full year period, starting six months before until six months after measurement. An extensive data collection took place to operate all variables, which we discuss below.

Dependent variable

We measure buying behavior as the share-of-wallet in a supermarket chain during a specific quarter:

SOW_{ist} = Share-of-wallet of household i in store s during quarter t,

$i = 1, \ldots, I$; $I = 1999$ (households),

$s = 1, \ldots, S$; $S = 20$ (supermarket chains),

$t = 1, \ldots, T$; $T = 10$ (quarters).

Independent variables: Loyalty programs

Concerning loyalty program memberships, three situations are possible:

1) A supermarket chain has a loyalty program and the household is member of it;

2) A supermarket chain has a loyalty program but the household is not a member;

3) A supermarket chain does not have a loyalty program.

We use two dummy variables to indicate the first two situations, and consider the last one as the base situation. If a household is a loyalty program member, the influence of the program is likely to depend on its design and on competitive loyalty program memberships. We let the main effect reflect a loyalty program with the most common design: a single vendor program with a saving component offering an average discount rate, namely 3.8%. We account for design differences by including variables representing the absence of a saving component, deviations from the average discount rate, and existence of a multi-vendor structure. Dutch Consumer Reports (2000) measured discount rate by taking a sample of loyalty program members' receipts and calculating the average obtained discount percentage. We also include the number of loyalty program memberships in other supermarket chains. In sum, the following loyalty program variables are introduced:

LPM_{ist} = 1 if supermarket chain s has a loyalty program, and household i is

member during quarter *t*, 0 otherwise (situation 1);

$LPNM_{ist}$ = 1 if supermarket chain *s* has a loyalty program, but household *i* is not a member during quarter *t*, 0 otherwise (situation 2);

$NSAV_s$ = 1 if supermarket chain *s* has a loyalty program without saving component, 0 otherwise;

$DISC_s$ = Discount rate offered by the loyalty program of supermarket chain *s* minus average discount rate on a loyalty program;

MV_s = 1 if supermarket chain *s* has a loyalty program with multi-vendor structure, 0 otherwise;

$LPMC_{ist}$ = The number of supermarket chains of which a household *i* is loyalty program member in quarter *t*, except for supermarket chain *s* itself.

Independent variables: Store characteristics

We include the store characteristics location, price level, and store surface as independent variables in our model. We obtained the number of outlets of a supermarket chain in each of the twelve provinces of the Netherlands in 2000 from *Elsevier Business Information*. Some supermarket chains are exclusively located in a limited number of provinces, while others are countrywide located. For each province, we measure distribution density as the number of outlets of a supermarket chain as a fraction of the sum of outlets over all chains. We apply this measure to an individual household, based on its province of residence.

We use Dutch Consumer Reports to determine the price level of supermarket chains. The Dutch Consumer Association compares the price of a fixed basket across supermarket chains except for discounters, with a sample of five outlets per chain. Six price measurements are available for the observation period, and for each quarter we use the measurement most close in time. We construct a categorical price variable

with three levels (low, medium, high), where all levels include the same number of stores. The three discounters are coded as low priced.

We use the average store surface of a supermarket chain, as reported yearly in the ACNielsen Vademecum. We use the measurement most close to the relating quarter. Store surface is positively related to assortment width and shopping space (Arnold, Oum, and Tigert 1983). We use the natural logarithm of store surface in our model to obtain an approximately normal store surface distribution. In sum, we introduce the following set of store characteristics:

$DENS_{ist}$ = Number of outlets of supermarket chain *s* as fraction of total number of supermarket outlets, in province of residence of household *i* during quarter *t*;

PH_{st} = 1 if supermarket chain *s* is high-priced during quarter *t*, 0 otherwise;

PL_{st} = 1 if supermarket chain *s* is low-priced during quarter *t*, 0 otherwise;

$SURF_{st}$ = Natural logarithm of average store surface of supermarket chain *s* in period *t*.

Independent variables: Household characteristics

We have socio-demographic information on household size and net household income of panel members. The socio-demographic variables are measured as deviations from the sample average, and included in the model as moderators of the store characteristics. In this way the main effect of a store characteristic measures the effects for an average household. So we introduce:

$HHSIZE_{it}$ = Number of persons in household *i* in quarter *t* minus average number of persons in a household;

$HHINC_{it}$ = Monthly income in 1,000 Euros of household *i* in quarter *t* minus average monthly household income.

MODEL SPECIFICATION

A model on the effects of loyalty programs on share-of-wallet yields some challenges. To be logically consistent, the model must produce estimates between 0 and 1 (*range constraint*), and the sum of estimates over all stores must equal 1 (*sum constraint*) (Hanssens, Parsons and Schultz 2001, p.121). Because a linear regression model does not meet these constraints, we use an attraction model instead. Attraction models have been widely used for modeling market shares (Leeflang et al. 2000, p.171), but can also be applied to household-level share-of-wallets. The basic idea is that the share-of-wallet of a store depends on its relative attraction to a consumer:

$$(1) \qquad SOW_{ist} = \frac{A_{ist}}{\sum_{s=1}^{S} A_{ist}}.$$

The attraction of a store A_{ist} is a linear function of loyalty program membership and store characteristics. We include loyalty program design elements and competitive program memberships as moderators of the loyalty program effect, and household characteristics as moderators of store effects (see Figure 1). We specify the attraction function as a Multi Nominal Logit Model, so that it becomes:

$$(2) \qquad A_{ist} = \exp(\beta_1 + \beta_{2ist} LPM_{ist} + \beta_3 LPNM_{ist} + \beta_{4it} DENS_{ist} + \beta_{5it} PH_{st} + \beta_{6it} PL_{st} + \beta_{7it} SURF_{st} + \nu_{ist}),$$

where

$$(3) \qquad \beta_{2ist} = \delta_{2,1} + \delta_{2,2} NSAV_s + \delta_{2,3} DISC_s + \delta_{2,4} MV_s + \delta_{2,5} LPMC_{ist},$$

$$(4) \qquad \beta_{mit} = \delta_{m,1} + \delta_{m,2} HHSIZE_{it} + \delta_{m,3} HHINC_{it}, m = 4,...,7.$$

The attraction model is non-linear, and must be rewritten to enable estimation of the parameter coefficients. We use the method of log-centering (Nakanishi and Cooper 1988), and obtain a log-linear specification from which we can estimate the parameter coefficients:

$$(5) \qquad \log \frac{SOW_{ist}}{(\prod_{s} SOW_{ist})^{1/S}} = (X_{ist} - \overline{X}_{i.t})'\beta_{ist} + u_{ist},$$

with $X'_{ist} = (1, LPM_{ist}, LPNM_{ist}, DENS_{ist}, PH_{st}, PL_{st}, SURF_{st})$,

and $\overline{X}_{i.t} = \frac{1}{S}\sum_{s=1}^{S} X_{ist}$.

Another challenge is that the dependent variable share-of-wallet is zero in a large number of cases, because a household only chooses a limited number of supermarket chains. An attraction model does not allow for these zeros, because the attraction of a supermarket chain cannot be zero (see equation (2)). Analyzing only those observations with a positive share-of-wallet is not a good solution, because share-of-wallet is positive conditional on the store being chosen. We expect that the factors that influence a household's store choice influence the share-of-wallet of chosen stores as well. If we do not allow for this dependency, the parameter estimates of a model for share-of-wallet is likely to be biased (Thomas 2001). Therefore we need a model that combines both share-of-wallet and store choice.

We introduce a selection variable $CHOICE_{ist}$ that indicates whether store *s* is in the choice set of household *i* during quarter *t*. We assume that a consumer chooses to visit a supermarket chain ($CHOICE_{ist}$=1) if the underlying utility $CHOICE^{*}_{ist}$ is

positive. We let $CHOICE^{*}_{ist}$ be linearly dependent on the same set of explanatory variables as used for the attraction function (see equations (2)-(4)). We combine store choice and attraction in a Tobit-II model (Verbeek 2000, p.209), which consists of a selection equation (store choice model) and a quantity equation (attraction model), and has the following form:

$$\log \frac{SOW_{ist}}{(\prod_{s} SOW_{ist})^{1/S}} = (X_{ist} - \overline{X}_{i.t})'\beta_{ist} + u_{ist} \text{ if } CHOICE^{*}_{ist} > 0, \tag{6}$$

$$SOW_{ist} = 0 \text{ if } CHOICE^{*}_{ist} \leq 0, \tag{7}$$

$$CHOICE^{*}_{ist} = X_{ist}'\gamma_{ist} + \varepsilon_{ist}, \tag{8}$$

$$\begin{pmatrix} \varepsilon_{ist} \\ u_{ist} \end{pmatrix} = NID\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_1^2, \sigma_{12} \\ \sigma_{12}, 1 \end{pmatrix} \right). \tag{9}$$

The Tobit-II model is estimated with maximum likelihood; the likelihood function is presented in Appendix A. The model corrects for the interrelation between store choice and share-of-wallet, because both decisions are integrated into one model. The model accounts for the fact that households differ in the number of stores they visit, because the share-of-wallet of a household is modeled as the attraction of the specific store divided by the sum of the attractions of the stores chosen by this particular household. In total there are 399,800 observations, i.e., for each of the 1999 households ten quarterly observations are available for each of the twenty supermarket chains. Both the share-of-wallet and choice decisions are modeled with seventeen explanatory variables and a constant, leading to 36 response parameters. In addition, the (co)variance parameters σ_1 and σ_{12} are estimated (see equation (9)). We

set the constraint σ_2 =1 to avoid identification problems (Verbeek 2000, p.208).

RESULTS

The Tobit-II model is overall highly significant ($\chi^2 = 6199.56, p < .01$), as are most individual variables in the model, even at 1%-significance level. The likelihood ratio test of independent equations is rejected ($\chi^2 = 16.3, p < .01$), implying that independent estimation of the selection and quantity equations would have led to significant biases. The pseudo R^2 of the model is .39, calculated as proposed by Laitila (1993). The coefficient parameter estimates of the model are reported in Table 2. In the selection equation, distribution density has a strong positive influence on store choice. Store choice is also positively related to loyalty program membership. Since the store choice equation is merely included to obtain unbiased effect estimates for the share of wallet model, we focus on the discussion of the latter model ((1)-(4)).

[Insert Table 2 about here]

We find that a loyalty program membership relates positively to store attraction (left-hand side Table 2). Store attraction is higher for a loyalty program member than for a non-program member in the same supermarket chain ($\hat{\delta}_{2,1} - \hat{\beta}_3 = 2.025, p < .01$), as well as for a customer of a supermarket chain without loyalty program ($\hat{\delta}_{2,1} = .509, p < .01$). These findings confirm Hypotheses 1a and 1b. Hypothesis 2 tests if the relation between loyalty program membership and share-of-wallet depends on loyalty program design. For the loyalty program without saving component, the positive effect of loyalty program membership on share-of-wallet is much lower ($\hat{\delta}_{2,2} = -.338, p < .01$). This finding is based on a comparison between seven loyalty programs with and one program without a saving component, but since the effect is

statistically significant and large in size, we confirm Hypothesis 2a. Higher discount rates do not significantly influence the store attraction of loyalty program members, so that Hypothesis 2b cannot be confirmed ($\hat{\delta}_{2,3} = .008, p = .14$). As hypothesized, multi-vendor programs have a larger effect on store attraction than single-vendor programs ($\hat{\delta}_{2,4} = .089, p < .01$, Hypothesis 2c). Competitive memberships dampen the positive effects of loyalty program membership on store attraction ($\hat{\delta}_{2,5} = -.139, p < .01$, Hypothesis 3). Most store characteristics and their socio-demographic moderators have a significant impact on store attraction and have the expected signs. Only a low price level and its moderators with household size and income have no significant impact on store attraction, compared to a medium price level. In sum, our empirical analysis confirms all hypotheses, except for Hypothesis 2b.

Size of Loyalty Program Effects

From the parameter estimates the magnitude of the effects are not directly apparent, because of the non-linear nature of the model. Further, the coefficients represent the effects of variables on attraction and not on share-of-wallet, which complicates interpretations. To obtain insight in the magnitude of the loyalty program effects, we do simulations for a representative household, and for each customer base of the supermarket chains.

Simulations for a representative household

We consider a representative household with average household size and income and compare model predictions by imputing sensible values for the explanatory variables. The household visits four supermarket chains per quarter, which is the median value for the panel households. We assume that these supermarket chains each have a

medium price level, and an average store surface and distribution density. We calculate the household's predicted share-of-wallet for different loyalty program scenarios, based on variations in design and competitive memberships. The results are presented in Table 3.

[Insert Table 3 about here]

In the base scenario without loyalty programs, the four supermarket chains are equally attractive so that the predicted share-of-wallet is .25 for each chain. If one of the supermarket chains has a loyalty program and the household is member, the predicted share-of-wallet increases as shown in the first column of Table 3. For an average loyalty program the predicted share-of-wallet increases to .36. The share-of-wallet is highest if it concerns a multi-vendor saving program (.38), and much lower for a program without saving component (.28). On the other hand, if a supermarket chain has a loyalty program but the household holds no membership, the predicted share-of-wallet is only 0.07.

The second and third columns of Table 3 represent situations in which the household holds respectively one and two competitive memberships. Comparison of the cells within a row shows a negative impact of competitive memberships on the predicted share-of-wallet. For an average loyalty program membership, the predicted share-of-wallet decreases from .36 to .32 and .29 when the household holds respectively one and two competitive memberships. For a multi-vendor program this is from .38 to .35 and .30, and for a loyalty program without saving component this is from .28 to .26 and .25. For a loyalty program without saving component, the predicted share-of-wallet of a member with competitive memberships is about the same as for a customer of a supermarket without loyalty program. This analysis for a representative household shows that the loyalty program effect depends strongly on

program design, and that the effect also differs between program members because of the competitive memberships they hold.

Simulations for supermarkets' customer bases

To obtain better insight in the loyalty program effects at the supermarket level, we consider the entire customer base of each supermarket chain *s*. We now perform what-if simulations for the existing households in the database, unlike in previous simulations that were done for a hypothetical, representative household. In attraction models better insight into effect sizes is often obtained by calculating the elasticities (e.g. Campo et al. 2000). However, dummy variables such as used for loyalty program membership can only take the values 0/1, so that we cannot calculate elasticities for our key variables of interest. Instead, we compare model predictions for the present situation (supermarket has a loyalty program) with the fictive situation in which the supermarket chain does not have a loyalty program.

We calculate the model predictions for the latter situation adapting all relevant loyalty program related variables. We account for both loyalty program members and non-members of a supermarket chain, because a non-program member has a lower predicted share-of-wallet than an average customer of a chain without a loyalty program (see Table 3). So these model predictions represent the situation of a comparable chain in terms of marketing mix and customer base, but without a loyalty program. Table 4 presents the effects of loyalty programs on average share-of-wallet and customer revenues per supermarket chain.

[Insert Table 4 about here]

Our findings indicate that the share-of-wallet of a company's customer base is positively related to the presence of a loyalty program. For most supermarket chains the average predicted share-of-wallet of customers is higher if a loyalty program is

available. On average, the share-of-wallet of the customer base is 0.02 or 5.3% higher compared to a situation without loyalty program. But between supermarket chains the effects differ between 11.3% and –3.8%, and for two loyalty programs the predicted share-of-wallets are lower than in a situation without loyalty program. Factors that explain these differences are: loyalty program design, competitive memberships, the membership rate, and the attractiveness of the store arising from other marketing-mix variables.

First, loyalty program designs differ in the presence of a multi-vendor structure and a saving component. The loyalty programs with multi-vendor structure (Airmiles and Rocks) both positively relate to share-of-wallet. Compared to the average loyalty program effect of 5.3%, Rocks has a larger effect than average (5.9%), and Airmiles a smaller effect (2.7%). Hence, the positive effect of a multi-vendor structure at the household level (controlling for other covariates) is only partly apparent at the chain level. The explanation is that these other covariates differ systematically between chains. For example, if a chain is already relatively attractive without loyalty program the marginal effect of a loyalty program membership on share-of-wallet is smaller (Hanssens, Parsons, and Schultz 2000, p.124). This applies particularly for the Airmiles card from Albert Heijn, a chain that has both a large store surface and a high distribution density. The loyalty program without saving component (Bonuscard) has only a weak positive influence on predicted share-of-wallet (2.5%), which confirms findings at the household level.

Second, loyalty program effectiveness depends on the number of competitive memberships the chain's program members hold as shown clearly on household level. Konmar has customers with the largest number of competitive cards on average (1.86) and its program is indeed very ineffective.

Third, the most important factor of the effectiveness differences is the membership rate of the customer base, being the percentage of customers who are loyalty program members. If customers are no loyalty program members, they miss all rewards and services offered by the program, which could potentially build up loyalty. The most effective loyalty program (Edah Card) has a high membership rate (85.6% vs. 80.0% average). The program with worst performance (Konmar card) has a membership rate of the loyalty program of only 68.8%.

Finally, loyalty program effectiveness depends on the attraction of the store in the base situation without loyalty program. We already observed that for the Airmiles card of Albert Heijn, but it also applies for Konmar that has a large store surface.

Though our measure of effect size is coarse (we predict share-of-wallets for the fictive situation of the absence of loyalty card), it indicates that loyalty programs on average enhance the share-of-wallet of a company's customer base. However, we also see that the loyalty program effect depends on a complex of factors such as program design and membership rate.

Customer Revenues

Next to share-of-wallet, it is relevant to know how loyalty programs affect customer revenues. Additional revenues depend on the loyalty program effect on share-of-wallet, but also on category expenditures. Table 4 shows the average additional revenue per customer for each supermarket chain. On average a loyalty program relates to € 46.48 additional revenue per customer per year, but again strong differences exist between supermarket chains. Overall, loyalty programs that are effective in terms of share-of-wallet show large revenue effects as well, but minor deviations exist. The multi-vendor programs show additional customer revenues below average (resp. € 28.32 and € 44.89). The loyalty program without saving

component (Bonuscard) enhances customer revenues with € 26.16. The largest effect is € 101.98 (COOP Club-Card) and the lowest € –30.09 (Konmar card). Hence, an analysis of customer revenues provides retailers insight into financial attractiveness of individual loyalty programs. To further calculate the profitability of a loyalty program, we would need (to us unavailable) information on operation costs of the program.

Loyalty Program Introductions

Supermarket chains without a loyalty program might consider a loyalty program introduction. Our model can predict the effects of such an introduction for each of the thirteen chains without a loyalty program. We calculate for all supermarkets the predicted effects of loyalty program introduction, assuming that the new loyalty program realizes a membership rate equal to the current average rate (80.0%). Table 5 presents the results for four arbitrary non-loyalty program supermarket chains, and the average effect for all thirteen chains.

[Insert Table 5 about here]

A new loyalty program will lead on average to an increase of .004 or 1.7% on predicted share-of-wallet, and € 8.63 on revenues. These effects are considerably lower than for the present loyalty programs, because many loyalty program members are already member of competitive programs. Further, given the high number of loyalty programs already in the market, a new loyalty program might find difficulty in realizing a membership rate equal to the current average rate (80%), which further diminishes effectiveness. In sum, our simulations indicate that it is doubtful if chains without a loyalty program should introduce one, given the high number of loyalty programs in the current market.

CONCLUSIONS

The objective of our study is to obtain better insight in the effectiveness of loyalty programs. We achieve this by studying a whole market and accounting for competitive effects and loyalty program design. We find that loyalty programs have on average a positive influence on share-of-wallet (H_1), but loyalty programs differ widely in effectiveness (H_2 and H_3).

In the first place, differences in loyalty program effectiveness relate to loyalty program design. Loyalty programs only lead to appreciable effects on share-of-wallet if the program has a saving component (H_{2a}). Though saving points represent often only low economic value, experimental studies have shown that saving points clearly stimulate the perception of saving (Hsee 2000). We proved the existence of this phenomenon in a real market setting as well. Though customers appreciate discounts (Dowling and Uncles 1997, Liebermann 1999), the discount rate on loyalty programs does not affect share-of-wallet (H_{2b} not confirmed). A multi-vendor structure improves customer loyalty to a larger extent than a single-vendor program (H_{2c}). This finding is in contrast with the suggestion of Sharp and Sharp (1997) that multi-vendor programs might be less effective, because they reward customers too easily. Apparently a multi-vendor structure improves customer's involvement in the program.

Second, a loyalty program is less effective if consumers have competitive loyalty program memberships (H_3), because these consumers might identify less strongly with an individual company and use the best rewards from each loyalty program. With this finding, we extend previous research of competitive effects (e.g. Leeflang and Wittink 2001) by showing that competitive decisions also relate to loyalty program effectiveness, via multiple memberships of consumers.

A third reason for differences in effectiveness is the membership rate of the loyalty program. A low percentage of customers being loyalty program members, implies that many customers are not exposed to the loyalty incentives given by a loyalty program. We demonstrate that loyalty program introductions can only be successful if they realize a sufficiently high membership rate, which may be hard if many customers already hold loyalty program memberships.

In our study we used share-of-wallet as a measure of loyalty. We found that loyalty programs lead to a 0.02 or 5.3% increase of share-of-wallet on average. We used the effects on share-of-wallet to calculate the implications for revenues, and found an average positive effect of € 46.48 per customer per year.

Finally, our analyses show the importance of household level analyses. Some loyalty program aspects could be masked with a study on aggregate level. E.g. the positive effect of a multi-vendor structure appears both from the parameter estimates (Table 2) and the simulations for a representative household (Table 3). However, in the simulations for an entire supermarket's customer base, the effectiveness of the multi-vendor program turned out to be lower than average, because other factors counterbalance the positive effect (Table 4). This might explain why Sharp and Sharp (1997) found very small effects of a multi-vendor loyalty program. Our study illustrates that household level data analysis can clarify aspects that are masked at the supermarket chain level.

DISCUSSION

Managerial implications

The results of this study could help managers to improve their decisions concerning loyalty programs. A company (re)considering the use of a loyalty program should

realize that loyalty programs are overall effective in enhancing share-of-wallet, but not in each individual case. First of all, loyalty program design influences effectiveness, and a company should carefully decide on this. A saving component gives explicit loyalty incentives by rewarding loyal members best. Our analyses show that a saving component enhances effectiveness considerably. Further, a company should consider cooperation with (non-supermarket) partners, to make the loyalty program an attractive entity to consumers, especially because the consumer's wallet includes many loyalty cards already. A company should try to find a partner with comparable organizational capabilities and preferably one with which a prior history of business relations exists (Bucklin and Sengupta 1993).

Second, our analyses showed the importance of a high membership rate. A company should stimulate regular customers to become members of the loyalty program, because non-members lack the loyalty incentives of the program. Further, a critical mass of consumers in the loyalty program stimulates word-of-mouth among customers about loyalty program benefits. In-store communications, such as flyers, displays and personnel communication of check-out employees should reach customers who are not loyalty program members yet.

Third, competitive loyalty program memberships are an important concern for loyalty program effectiveness. Shapiro and Varian (2000) considered loyalty programs as a means to lock-in consumers in markets where switching costs are low. But this lock-in mechanism loses effectiveness if different loyalty programs lock-in the same consumer. Though not under its direct control, a company should try to avoid multiple memberships among its customers. By providing rewards especially attractive for loyal customers and avoiding rewards that stimulate cherry picking behavior such as price discounts, a supermarket chain could avoid the existence of too

many duplicate memberships. Supermarkets considering a loyalty program introduction should realize that many customers already hold loyalty program memberships. A clear inspection of competitors and their loyalty programs could help a manager to assess whether a loyalty program could be effective.

Limitations and Further Research

We undertook a market wide study of all loyalty programs in the Dutch supermarket industry and found overall positive effects of loyalty programs on share-of-wallet. Given that the relationship proneness and product category involvement of consumers is low in this industry, we could expect these effects to be even larger in other industries, such as clothing retailing (De Wulf, Odekerken-Schröder, and Iaccobucci 2001).

In our study we focused on loyalty programs as a means of improving loyal behavior, but we did not consider that a motivation of introducing loyalty programs could be to obtain purchase data (Day 2000). A loyalty program provides the company with full information of customers' buying behavior, and could be enriched with socio-demographics and causal information such as price promotions. Rossi, McCulloch, and Allenby (1996) show a high value of using this information for target marketing, e.g. providing coupons to certain customer groups. Such a strategy of direct marketing fulfills customer needs more specifically, so that marketing money is spent more efficiently.

Further, we studied the effects of loyalty programs but did not consider its costs. The operation of a loyalty program involves various costs, on which we had no information. The costs of rewarding members differ between loyalty programs, because of differences in loyalty program design and usage intensity of the loyalty program by members. To make a balanced choice on loyalty program design a

company should account for these cost differences.

Overall, our research shows that loyalty programs positively affect share-of-wallet, but the effectiveness depends strongly on loyalty program design, competitive memberships, and customer base characteristics. Several opportunities exist to study loyalty programs further, such as the effectiveness of loyalty programs in other industries, the use of obtained loyalty card data, and relative profitability compared to other relational instruments.

TABLE 1
Information on Supermarket Chains with a Loyalty program

	Loyalty Program				Market Share (in 2000)		Customer Base Characteristics (Based on Panel Households)		
Supermarket Chain	Loyalty Program	Saving Component	Multi-Vendor Structure	Discount Rate	Market Share %	Market Share Rank	# Stores visited	% Loyalty Program Members	# Competitive Cards held by Loyalty Program Members
Albert Heijn	Bonuscard	No	No	4%	24%	1	3.57	80.1%*	.98
	Airmiles	Yes	Yes	0%	24%	1	3.57	24.8%*	.95
SuperdeBoer	Rocks	Yes	Yes	0%	9%	3	3.94	69.5%	1.33
Edah	Edah Card	Yes	No	5%	8%	4	4.03	85.6%	1.43
Integro	KisK	Yes	No	2%	7%	6	4.12	67.3%	1.50
Konmar	Konmar card	Yes	No	5%	3%	9	4.35	68.8%	1.86
COOP	COOP-Club	Yes	No	3%	1%	17	3.87	80.2%	1.53
Jan Linders	Voordeelcard	Yes	No	9%	1%	18	3.86	87.5%	1.62

* Overall 83.6% of Albert Heijn's customers are loyalty program member, and 21.4% of the customers are members of both programs.

TABLE 2

Results of Tobit-II model

Explanatory Variable:		ATTRACTION (Share-of-wallet) Parameter Estimate	*t*-Value	CHOICE Parameter Estimate	*t*-Value
Constant	β_1	.048	3.29*	–1.573	–73.03**
Single-vendor Saving Program	$\delta_{2,1}$	.509	17.25**	.784	40.60**
+ No Saving function	$\delta_{2,2}$	–.338	–13.76**	–.723	–35.09**
+ Discount rate	$\delta_{2,3}$	.008	1.46	.253	68.71**
+ Multi-vendor program	$\delta_{2,4}$	.089	3.48**	.040	1.66
# Competitive memberships	$\delta_{2,5}$	–.139	–10.42**	–.033	–3.70**
No Membership	β_3	–1.516	–59.26**	–.530	–51.97**
Distribution Density (DENS)	$\delta_{4,1}$	1.146	9.19**	9.919	188.51**
Price High (PH)	$\delta_{5,1}$	–.144	–7.96**	–.144	–17.29**
Price Low (PL)	$\delta_{6,1}$	.017	0.91	.209	27.54**
Store size (SURF)	$\delta_{7,2}$	.311	14.98**	.001	1.29
DENS*HHSIZE	$\delta_{4,2}$	.176	2.42*	.062	1.83
DENS*HHINC	$\delta_{4,3}$	.307	4.23**	.069	1.97*
PH* HHSIZE	$\delta_{5,2}$	–.167	–12.81**	–.036	–5.64**
PH*HHINC	$\delta_{5,3}$	.050	3.74**	.019	2.99**
PL*HHSIZE	$\delta_{6,2}$	.023	1.69	.062	12.07**
PL*HHINC	$\delta_{6,3}$	.018	1.32	–.036	–6.93**
SURF*HHSIZE	$\delta_{7,2}$	–.102	–6.79**	–.012	–5.09**
SURF*HHINC	$\delta_{7,3}$	.166	11.38**	.001	.64**
	σ_{12}	–.054	.014		
	σ_1	1.278	.004		

** $p<.01$ * $p<.05$

TABLE 3

Share-of-wallet of a customer for different loyalty program situations

Loyalty Program Membership:			**# Competitive Loyalty Program Memberships:**		
Loyalty Program	Member-ship	Design	0	1	2
No	No	Not applicable	.25	.24	.22
Yes	No	Not relevant	.07	.06	.06
Yes	Yes	Single-Vendor, Saving Component	.36	.32	.29
Yes	Yes	Multi-Vendor, Saving Component	.38	.35	.30
Yes	Yes	Single-Vendor, no Saving Component	.28	.25	.22

TABLE 4
Average Changes in Share-of-Wallet and Revenues Of the Customer Base Due to Loyalty Program

		ΔSOW		ΔRevenue	
Supermarket Chain	Loyalty Program	Change in Share-of-Wallet	% Change in Share-of-Wallet	Yearly Change in Customer Revenues	
Albert Heijn		.019	4.8%	€	49.75
- Airmiles	Airmiles	.011	2.7%	€	28.32
- Bonuscard	Bonuscard	.010	2.5%	€	26.16
Super de Boer	Rocks	.017	5.9%	€	44.89
Edah	Edah Card	.037	11.3%	€	92.77
Integro	KisK	–.006	–2.2%	€	–16.52
Konmar	Konmar card	–.010	–3.8%	€	–30.09
COOP	COOP-Club	.040	10.9%	€	101.98
Jan Linders	Voordeelcard	.030	10.3%	€	82.61
Average		**.02**	**5.3%**	**€**	**46.48**

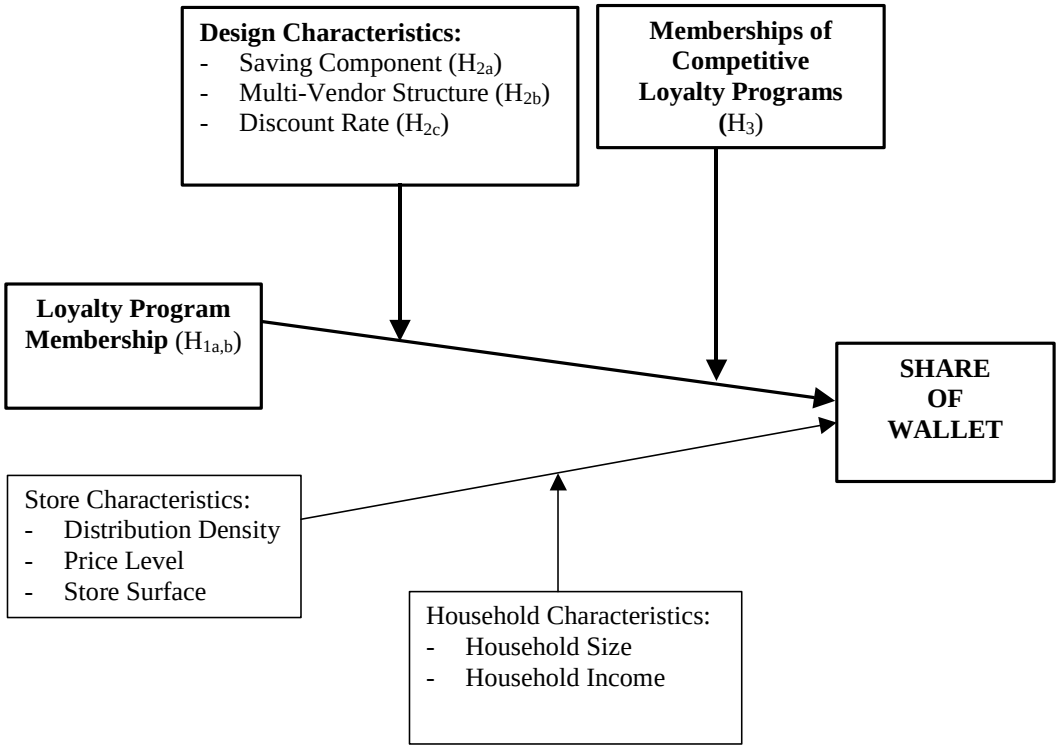
TABLE 5
The Effectiveness of a Loyalty Program Introduction

			ΔSOW		ΔRevenue	
Supermarket Chain	Market Share	Market Share Rank	Change in Share-of-Wallet	% Change in Share-of-Wallet	Yearly Change in Customer Revenues	
C1000	.11	2	–.001	–.04%	€	–3.54
Koopconsult	.06	6	.023	7.58%	€	56.79
A&P	.04	11	.003	1.57%	€	73.67
Dekamarkt	.02	15	.001	.30%	€	.03
Average across all 13 chains			**.004**	**1.7%**	**€**	**8.63**

* We assuming a membership rate of 80% for the introduced loyalty program.

FIGURE 1

Conceptual Framework



APPENDIX A

LIKELIHOOD FUNCTION

The likelihood of the model is (Verbeek 2000, p.211):

$$\text{(A1)}\quad \begin{aligned} L &= \prod_0 p(CHOICE^*_{ist} \le 0) \prod_1 f(SOW_{ist} \mid CHOICE^*_{ist} > 0) P(CHOICE^*_{ist} > 0) \\ &= \prod_0 p(CHOICE^*_{ist} \le 0) \prod_1 f(SOW_{ist}) P(CHOICE^*_{ist} > 0 \mid SOW_{ist}) \end{aligned} .$$

The expressions for the components of the likelihood-function are shown in equations A2-A4.

$$\text{(A2)}\quad p(CHOICE^*_{ist} \le 0) = 1 - \Phi(X_{ist}'\gamma_{ist}),$$

$$\text{(A3)}\quad f(SOW_{ist}) = \frac{1}{\sqrt{2\pi\sigma_1^2}} \exp\left\{ \left(-\frac{1}{2} \left(\frac{\log SOW_{ist}}{\log(\prod_s SOW_{ist})^{1/S}} \right) - (X_{ist} - \overline{X}_{ist})'\beta_{ist} \right)^2 / \sigma_1^2 \right\},$$

$$\text{(A4)}\quad P(CHOICE^*_{ist} > 0 \mid SOW_{ist}) = \Phi\left(\frac{X_{ist}'\gamma_{ist} + (\sigma_{12}/\sigma_1^2)(\log SOW_{ist} - \log(\prod_s SOW_{ist}))^{1/S} - (X_{ist} - \overline{X}_{1i.t})'\beta_{ist}))}{\sqrt{1 - \sigma_{12}/\sigma_1^2}} \right).$$

APPENDIX B

DATA SOURCES

Source	Obtained data
GfK Panel Services 1998-2000	Buying behavior of Dutch households in supermarkets, loyalty program memberships and socio-demographics of the households
Dutch Consumer Reports 2000	Provided Discount Rate of Dutch Supermarket Loyalty Programs
Dutch Consumer Reports 1998-2000	Price Level Dutch Supermarket Chains
Elsevier Business Information 2000	Outlet Locations of Dutch Supermarket Chains
ACNielsen Vademecum 1998-2000	Outlet sizes of Dutch Supermarket Chains
GfK yearguide 2000	Loyalty Program Membership rate of Dutch households in supermarkets.
ACNielsen Consumer Insight 2000	Loyalty Program Membership rate of American households in supermarkets.

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