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WORKING PAPER

Customer Attrition Analysis For Financial Services Using Proportional Hazard Models

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Abstract. This paper studies the topic of customer attrition in the context of a European financial services company. More specifically, we investigate predictors of churn incidence as part of customer relationship management (CRM). We contribute to the existing literature: (1) by combining several different types of predictors into one comprehensive retention model including several 'new' types of time-varying covariates related to actual customer behaviour; (2) by analysing churn behaviour based on a truly random sample of the total population using longitudinal data from a data warehouse. Our findings suggest that: (1) demographic characteristics, environmental changes and stimulating 'interactive and continuous' relationships with customers are of major concern when considering retention; (2) customer behaviour predictors only have a limited impact on attrition in terms of total products owned as well as the interpurchase time.

Keywords: Banking, marketing, retention modelling, proportional hazard model, Cox regression.

1. Introduction

In an era of mature markets and intensive competitive pressure, more and more companies do realise that their most precious asset is the existing customer base (Athanassopoulos, 2000; Jones et al, 2000; Thomas, 2001; Colgate et al, 1996; Paulin et al, 1998, Mols, 1998). This evolution has resulted in a rise in attention to customer relationship management (CRM). This also holds for the financial services sector in which deregulation, new entrants (Ritter, 1993) and an intensive European financial integration (Pastor et al, 1997; Paulin et al, 1998; Dawes and Swailies, 1999) have created an environment that allows customers considerable choice in satisfying their financial needs (Colgate and Danaher, 2000; Mittal and Katrichis, 2000). The economic value of customer retention is widely recognised in literature: (1) Successful customer retention lowers the need for seeking new and potentially risky customers, and allows organisations to focus more accurately on the needs of their existing customers by building relationships (Dawes and Swailes, 1999; Engel et al, 1995); (2) Long-term customers buy more (Paulin et al, 1998; Ganesh et al, 2000) and, if satisfied, may provide new referrals through positive word-of-mouth for the company (Ganesh et al, 2000; Colgate et al, 1996); (3) Long-term customers become less costly to serve due to the bank's greater knowledge of the existing customer and to decreased servicing costs (Ganesh et al, 2000; Paulin et al, 1998); (4) They tend to be less sensitive to competitive marketing activities (Colgate et al, 1996); (5) Losing customers not only leads to opportunity costs because of reduced sales, but also to an increased need for attracting new customers (Athanassopoulus, 2000), which is five to six times more expensive than customer retention (Bhattacharya, 1998; Colgate and Danaher, 2000; Rasmusson, 1999).

Many researchers have already investigated the switching behaviour of financial services customers, which underlines once more the relevance of the topic in this sector. In this study, we define a 'churned' customer as someone who closed all his/her accounts. We contribute to the existing body of research at three levels: Firstly, by combining three categories of predictors of churn behaviour (that is, customer behaviour, customer demographics, and macro environment) into one study, whereas most existing studies only tested the impact of one or two retention predictor

categories. Secondly, most previous retention studies (particularly in the financial industry) collected data using questionnaires with the inherent sample selection bias. We analyse the churn problem by observing (a random sample of) the total population for a substantial period of time. Thirdly, we observe a customer from the moment he/she starts a relationship with the company until he/she leaves the company or until the end of the observation. Consequently, both dependent and explanatory variables can be situated in time. Additionally, predictors with a time-varying character are allowed to take different values over time. Several authors highlighted the importance of integrating time-dependent variables because of better model performance (Van den Poel and Leunis, 1998), and because of more accurate forecasts (Weerahandi and Moitra, 1995). Moreover, literature reveals the benefits of using large observational databases that have long-term follow-up for a large number of individuals: such as, no improved generalisability of the results or the ability to compare customers' long-term predictors under different circumstances (DeLong et al, 2001).

This paper is organised as follows. In Section 2, we provide a concise overview of attrition modelling in the context of the financial services industry. Next, the field of survival analysis is presented in Section 3, followed by a discussion of the theoretical underpinnings of the proportional hazard model. The data set, the list of predictors along with the tested hypotheses and the findings of the empirical study are presented in Sections 4, 5 and 6 respectively. A general conclusion, the limitations of the study and some directions for further research are covered in Sections 7 and 8.

2. Attrition Modelling in the Financial Services Industry

The substantive relevance of attrition modelling comes from the fact that an increase in retention rate of just one percentage point may result in substantial profit increases, as the following real-life example of the actual financial services company illustrates. Suppose that the financial services company serves 1 million customers and that the average defection rate amounts to 7 percent and the average net contribution per customer (per year) amounts to 50 Euro, which represent the real-life situation of the company.

INSERT TABLE 1 ABOUT HERE

Table 1 compares the economics of several alternative retention rates. In the actual situation, we can expect to keep each year 93 % (=100 % - 7 %) of all customers. We also included results for a retention rate of 75 %, the situation reported by Clark (1997) of a major UK retail bank. The ideal situation with retention rates of 100 % is utopian, because of uncontrollable reasons of defection. Natural death or the fact of moving to a foreign country (or different region) are common examples of events that are out of control of the company that may result in customer attrition. Suppose further, that insights in churn behaviour due to analysis (such as the one presented in this paper) allows the company to retain one percentage point more of its actual customer base, that is, a retention rate of 94 %. This will result in a substantial change in contributions. This improvement in retention will directly increase the contribution from 392.2 million Euro to 419.7 million Euro, that is, by 27.5 million Euro, when considering a time period of 25 years and a 6 % discount rate. The dramatic impact of different retention rates on cumulative profit is shown in Figure 1.

INSERT FIGURE 1 ABOUT HERE

Given a tendency of increasing customer knowledge (Rasmusson, 1999; Pollay and Mittal, 1993) and a more competitive environment (Colgate and Danaher, 2000; Jones et al, 2000; Dawes and Swailies, 1999), we can easily ascertain the increasing importance of attrition analysis. Making use of churn behaviour insights may result in higher retention rates, and more specifically in higher profits when offering the appropriate actions.

In general, four sets of variables appear in the retention literature: customer behaviour, customer perceptions, customer demographics and macro environment variables. In Table 2, we present a literature overview of the independent variables that are assumed to have an impact on churn behaviour. Most attrition research focusses on one or two predictor categories and is conducted in the financial services industry.

INSERT TABLE 2 ABOUT HERE

Conceptually, the churn-incidence issue reduces to the general problem of binary classification: churn or not. Attrition models focus on the switching behaviour of customers. Two notable types of attrition models can be distinguished based on the time window of observation. Static attrition models investigate churn behaviour at a specific moment in time, while dynamic attrition models observe a set of individuals for a substantial period of time. Models that make it possible to estimate the risk or hazard rates, which change over time are preferred, because they produce more accurate forecasts than models that do not allow variables to take another value over time (Weerahandi and Moitra, 1995). The 'Methodology Section' column in Table 2 reveals that most authors use a static attrition model to investigate the switching behaviour in a particular research environment (by investigating incidence with non-time varying variables); they collected data using questionnaires on a limited sample of the total population of customers. Although dynamic models are often used in many disciplines, such as biology, medicine, economics, engineering, sociology and psychology (Wedel and Kamakura, 1995; Morita and Lee, 1993; Allison, 1995) few researchers made use of them to investigate customers' churn behaviour. Moreover, most dynamic retention models are limited in the sense of "being dynamic" by only considering the time aspect for the dependent variable (that is, the churn event). Applying dynamic attrition models - in the broadest meaning of being "dynamic"- also requires the collection of all changes in value of the covariates for the customers who are observed during a particular time window. A possible alternative approach for obtaining the necessary time-varying covariate data can be found in the use of panels; that is, a longitudinal survey in which the same sample units respond to the same questionnaire repeatedly at two or more points in time (Golany et al, 1995). Although this approach involves a 'period by period' discrete time measurement, researchers opting for this type of data collection still have to proceed with caution for problems of representativeness due to the sampling when generalising the result to the whole population (Mols, 1998). To the best of our knowledge, this study contributes to the literature by being the first to use time-varying covariates from three different categories of independent variables to assess both the incidence and timing of the churn event using a data warehouse (cf. Table 2).

3. Survival Analysis and Proportional Hazard Modelling

Survival analysis is a class of statistical methods modelling the occurrence and timing of events (in casu: customer attrition) with the aim to establish descriptive or predictive models in which the risk of an event depends on covariates.

All of the standard approaches to survival analysis are probabilistic or stochastic. That is, the times at which the events occur are assumed to be realisations of some random process. It follows that T, the event time for some particular customer, is a random variable having a probability distribution.

Let us denote the probability density function (p.d.f.) of this variable by f(t). The cumulative distribution function (c.d.f) of variable T, denoted by F(t). Hence,

$$F(t) = \Pr\{T \leq t\}. \quad (1)$$

For some individuals the time to failure may be observed completely, whereas for others we only have partial observation until some specific censoring time c. In survival analysis, it is common to work with a closely related function called the survivor function, defined as:

$$S(t) = \Pr\{T > t\} = 1 - F(t). \quad (2)$$

This leads to the following relationships:

$$f(t) = \frac{dF(t)}{dt} = -\frac{dS(t)}{dt}. \quad (3)$$

The hazard function is a central topic in the field of survival analysis and is defined as:

$$h(t) = \lim_{\Delta t \to 0} \frac{\Pr\{t \leq T < t + \Delta t / T \geq t\}}{\Delta t}. \quad (4)$$

The aim of the definition is to quantify the instantaneous risk that the event will occur at time t.

The proportional hazard model introduced by Cox dominates the field of the dynamic survival models (Stare et al, 2001; Allison, 1995). In this study we also use the Cox model. The technique allows to incorporate time-varying covariates and both discrete and continuous measurements of event times and the technique can handle observations that did not experience the event (that is, censored observations). The

proportional hazard model appears to be very robust and requires few assumptions (Kumar and Westberg, 1997). However, proportional hazard models have the important key assumption of proportionality, which is often overlooked when applying the technique (Morita and Lee, 1993; Boucher and Kerber, 2001; Therneau and Grambsch, 2000). Proportionality implies that the hazard for any individual is a fixed proportion of the hazard of any other individual (hence the name 'proportional hazard'). Proportional hazards require that there be no interaction between covariates and time. The group of time varying covariates are an exception to this rule; and are allowed to vary with time; that is, the conditional probability of the event remains constant unless the explanatory variables take on a different value over time. Thus, the ratios of the hazard do not remain constant when incorporating time-varying covariates into the model; however, this does not create a real problem for the likelihood estimations (Allison, 1995). Proportionality can easily be investigated by testing whether the interaction between the non-time varying covariates and time is significant or not. Plotting the scaled Schoenfeld residuals versus some function of time g(t) offers a powerful tool to investigate the basic assumption for a model containing both static and time-dependent covariates. A line can be fit to the plot; a zero slope gives evidence for proportional hazards (Therneau and Grambsch, 2000). A visual inspection of the plots for the significant predictors in our attrition model reveal the evidence for proportional hazards.

INSERT FOOTNOTE 1 ABOUT HERE

4. The Data Set of the Empirical Study

We obtained data from a European financial services company that both offers banking and insurance services towards customers. Their data warehouse gathers information from the banking customers and contains both data on past purchase behaviour, that is, we know when a customer purchased what quantity of a particular banking product and data on customer characteristics. The total data set consists of a random sample of 47.157 customers from whom 47 % experienced the churn event over a period of 77 years. For this sample composition we ensured that about as many censored cases as uncensored cases were taken into the analysis, because many

authors emphasise the need for a balanced sample in order to reliably discriminate between defectors and non-defectors (Rust and Metters, 1996; Dekimpe and Degraeve, 1997; Yamaguchi, 1992). For each customer the variables are measured from the moment they became customer until the moment of lapsing or censoring (that is, 1 May 2001). We presume that analysing observations from their initial time origin outperforms a data set only containing data from a specific moment in time, because the latter situation implies neglecting the initial values of the covariates for people that became customer before the start of observation.

The data used in this paper contains some missing values - which is also often a very common problem in other empirical research (Raaijmakers and Quinten, 1999). A solution consists in imputing values for the missing data, using the data that are not missing. In this study the explanatory variables that belong to the customer demographics predictor category can have missing values for some observations. The missings range for 2 % (for the variable 'gender') till 20 % (for the geo-demographic variables). We applied the 'Tree imputation with surrogates' as replacement procedure, available in the SAS Enterprise Miner software package. This procedure assigns imputed values to the missing ones based on the values of the other (non-missing) variables. The 'Tree imputation with surrogates' uses a decision tree to estimate the replacement values. In this study, these values are created based on the remaining non-time-varying explanatory variables or some surrogate variables. The latter variables are used whenever a split variable - that is used in the decision tree – has a missing on its own. Additionally, we have created an extra dummy variable per covariate that deals with missing values. The extra variables take on the value of 1 or 0 depending on whether they represent an imputed or a real value.

Another problem that often arises in empirical studies is the existence of highly correlated explanatory variables; that is mulicollinearity (i) makes the parameter estimates unreliable and (ii) inflates the standard errors (Leeflang et al, 2000; Morrow-Howell, 1994). As stated by Pedhazur (1982): 'the existence of too high a correlation remains a judgment on the part of the researcher'. An additional difficulty in this study is caused by the time-varying nature of most of our explanatory variables. Since customers can have more than one value for a specific predictor (at different moments during their life time) one needs to find a "dynamic" way of

dealing with intercorrelations. We defined our multicollinearity approach based on (i) the paper by Mitra and Golder (2002) who also consider time-varying independent variables and multicollinearity in their study and (ii) the comments given by Leeflang et al. (2000) who argue to be cautious with correlations that might change over time. We decided to investigate correlations between variables at each (discrete) year over a (maximum) period of 77 years (which represents the longest duration time in our data set). This approach has the advantage of avoiding time-specific outliers with regard to correlations and offers a viable alternative compared to a simple 'one-moment-cherry-picking' method. Similar to the procedure proposed by Mitra and Golder (2002) we sequentially added variables to our model to assess the stability of the parameters and hence to ensure that multicollinearity has no harmful impact on the results. We decided to handle different correlation cut-offs starting from .20, and then sequentially introducing new variables into the model based on a less restrictive (and hence higher) cut-off point. The findings reveal that (i) a .80 cut-off constitutes too high a correlation cut-off value for this study, whereas (ii) lower cut-off values tend to result in more stable parameter estimates, and (iii) a .40 correlation cut-off seems to be an appropriate benchmark (cf. Table 6 and Section 6).

The aim of this study is to investigate whether customers will churn or not. In a real life situation customers may defect because of many reasons, which involves different types of failure (Morita and Lee, 1993). For example, bank customers may churn because of dissatisfaction with the service, a new tempting offer by a competitor or just because of death. Often only one type of failure is of interest in the research and is treated as the one and only type of event to be investigated (Oakes, 2001; Allison, 1995). In this study, we opt to mainly focus on reasons of failure that are not out of control of the company. Therefore, we excluded customers from whom we had certainty about the fact that they defected because of a natural death.

5. Predictors and Hypotheses

As discussed in Section 2, an extensive literature search combined with many personal interviews with managers revealed four broad categories of variables for which we could hypothesise a relationship with retention, three of which we have data

available in this study: customer behaviour, customer demographics and macro environment. With regard to the fourth category (that is, customer perception in Table 2), we were not able to include this type because it was not available; which consequently constitutes a limitation of this study. However, we have to mention that even if it were available, it would not necessarily be advantageous to include it since it could create a possible bias in the sample (those customers who respond to a satisfaction questionnaire need not necessarily be a random sample). As most previous studies (cf. Table 2) mainly used questionnaire data (and, hence, measure customer perceptions) to study the problem of customer attrition, we believe it is useful to approach the issue of customer attrition from another angle (that is, the behavioural perspective using data from an in-house data warehouse). However, for further research, it would be appealing to test these two issues and to analyse customer attrition based on a comprehensive model including all predictor categories, which implies the need to integrate both data warehouse and survey data. This will require a carefully designed and executed data collection effort. Hence, we also decided to formulate some hypotheses with regard to perceptual variables (cf. Section 5.4).

Table 3 gives an overview of the predictors used in this paper and provides both a classification into quantitative (numeric) versus qualitative (categorical) variables, and time-invariant versus time-dependent predictors.

INSERT TABLE 3 ABOUT HERE

5.1. Customer Behaviour Predictors

The following paragraphs discuss the customer-behaviour covariates considered in this study. The corresponding hypotheses are summarized in Table 4.

1) *Product ownership.* Some researchers investigated the impact of product ownership on switching behaviour. Given the inconclusive evidence in the literature, we only hypothesise an impact of product-specific ownership on customer attrition without an a priori expectation of the direction of the impact. In this study, we include seven product-specific ownership dummy variables. The ownership variables are time varying and can take the value of 0 (no possession) or 1 (possession) over the whole lifetime of the customer.

2) *Total product ownership*. Over time, the customer can own different kinds of products. Previous research also investigated the impact of the total number of products owned by a customer on his/her retention behaviour. Pohani et al (1998) revealed in their study that the more products a customer possesses with the bank, the longer he or she is likely to remain a customer. As such, we hypothesise a positive relationship between the total number of products owned by a customer and his/her likelihood to remain customer. The created variable represents the total number of products over time.

INSERT FOOTNOTE 2 ABOUT HERE

3*) Interpurchase time.* The customers' interpurchase time might influence his/her switching behaviour. Interpurchase time can be defined as the time elapsed between two purchases. When considering interpurchase times, Vilcassim and Jain (1991) found that with the passage of time the likelihood of a switch increased. On the other hand, Bhattacharya (1998) also hypothesised a positive relationship between the interrenewal times of a membership organisation and the hazard of lapsing, but – contrary to what was expected - found a significant negative effect. Moreover, he investigated the effect of upgrades (i.e. renewing at the same or higher level) and downgrades (i.e. renewing at a lower level) in interrenewal times on churn. Only the latter was found to have a significant and positive impact on churn, whereas upgrades were not found to influence the switching behaviour. Due to the inconclusive evidence, we only hypothesise that interpurchase times might influence the customer's decision to leave the company. In our study, we introduce the predictor 'average interpurchase time' which varies over time and takes a new value, every time a customer buys a new product.

4) *Home and phone banking.* Since the financial environment has changed (cf. Section 1), the customer is facing new ways of interacting with its banking institution. Both Hitt and Frei (2002) and Mols (1998) investigated the effect of using PC banking (which is a synonym for home banking) on defection. The first authors found a positive (and significant) relationship between PC banking and retention rates. On the other hand, Mols also assumed that customers using PC banking are less inclined to switch to another bank, because of the extra efforts they have done to use the service. However, he found this (negative) relationship not to be significant. In our

study, we also decided to hypothesise a higher likelihood to stay for customers using home or phone banking. The covariates change over time, because it is plausible that although a customer did home or phone banking in the past, he stopped using these services, or the other way around. If a customer is doing home or phone banking, their respective indicator variable receives the value 1, in the other case the variable gets the value of 0.

INSERT TABLE 4 ABOUT HERE

5.2. Customer Demographic Predictors

The following paragraphs discuss the customer demographic covariates considered in this study.

1) *Age.* Table 4 reveals that existing empirical evidence is inconclusive with regard to this variable. Consequently, we only hypothesise that age has an impact on the customer's switching behaviour, without specifying a direction of that relationship.

2) *Gender*. Mittal and Kamakura (2001) tested for differences between men and women in their study with regard to churn behaviour. They found that women have a higher probability to stay with the company. Dekimpe and Degraeve (1995) also hypothesised a longer mean duration for women, but found opposite results, that is, women had a higher probability to quit. As such, we are unable to formulate an expected relationship between gender and the customer's switching behaviour. We incorporated a dummy variable 'gender' expressing whether the specific customer is a man (the value equals 1) or a woman (the value equals 0).

3) *Level of education*. Several authors investigated the relationship between the education level and the likelihood to stay. Mittal and Kamakura (2001) found that better educated people tend to have lower levels of retention. On the other hand, both Colgate and Danaher (2000) and Dekimpe and Degraeve (1997) argue that there is no significant relationship between the level of education and attrition. Contrary to these findings, Keaveney and Parthasarathy (2001) found a positive relationship between retention and education level. We choose to formulate our hypothesis based on the findings of Colgate and Danaher, because their research was carried out in the banking industry, while Mittal and Kamakura investigated the automotive industry and Keaveney and Parthasarathy the retail sector. In this study we use the numeric

variable ‘education’ which ranges from 1 through 7, meaning that the higher the number, the higher the level of education. We acknowledge that this variable may not be exactly interval scaled, but believe that it is a good approximation.

4) *Geo-demographic data: social status and potential.* Mittal and Kamakura (2001) also checked for the impact of the customer’s place of living on his/her attrition behaviour. They conclude that the area of residence has no significant impact on the decision to remain customer. For each customer in the analysis we include two variables expressing specific characteristics: ‘social status code’ and ‘social potential code’. These data were not available at the individual level, but could be obtained at the level of the neighbourhood. The ‘social status code’ consists of four groups. Therefore we create three dummy variables per customer in order to know to which categorical group he/she belongs. The four groups are: elite, high status, medium status, and low status. The ‘social potential code’ is a numeric value ranging from 1 (very low potential) to 10 (very high potential). Based on previous findings, we hypothesise that both the social status of the customer and his/her potential have no impact on retention.

5.3. Macro Environment Predictors

In order to test for the effects of macro-environment changes on the customers’ churn behaviour, we decide to create the variables ‘prosperity index’ and ‘merger’. The following paragraphs discuss the customer demographic covariates considered in this study.

1) *Prosperity.* Including a variable like the ‘prosperity index’ is motivated by the fact that, for example, one person who became customer in 1963, and another one who started a relationship with the company in 1990 experienced both another environment and changes. The first customer experienced the oil crisis after being a customer for 10 years, while the other customer experienced a flourishing economy after being 10 years customer. Since we observe each individual in our analysis from the moment they became customer till the moment of lapsing or censoring (cf. Section 4.1), we deal with different macro environments for each customer when considering a certain duration time. Therefore, we include the ‘GNP per capita’ as a measure for prosperity into the analysis, which represents the public purchasing power. For each customer we include one ‘prosperity’ value per year over their entire lifetime of being

a customer in order to account for the time-varying nature of this variable. We hypothesise that the prosperity of the macro environment that is typical for a certain moment in time influences the churn behaviour.

2) *Merger*. Since the actual financial services industry underwent some fundamental changes (cf. Section 1), we decided to include a factor in our analysis that encompasses these new evolutions. In the literature, it is stated that mergers and acquisitions can upset customers and may cause them to look for alternatives (Wehner, 2000). Taking this information into consideration, we hypothesise that customers are more inclined to churn after an organisational change takes place. The financial services company that provides the data for this analysis also experienced a merger. Therefore, we have created a time dependent 'merger' variable for each customer, that takes on the value of 1 from the moment that the particular customer experienced the merger. Customers who became customer after the event or who already churned before the merger, have all zeros for the variable.

5.4. Customer Perception Predictors

As stated above, we are unable to investigate the impact of customer perception variables in our study because of the unavailability of these data; nevertheless it might be appealing to include these predictors in future research. Hence, we formulate some hypotheses representing the relationship between perceptual variables and the target variable (that is, the churn incidence). Table 5 gives an overview of previous retention findings with regard to the customer perception category.

INSERT TABLE 5 ABOUT HERE

It is clear from Table 5 that an enormous variety of perception variables have been investigated in previous retention research. Considerable efforts have been done to explore the impact of overall customer satisfaction, service quality and relational performance on (intended) retention behaviour. But also other and less common perception constructs have been analysed, such as "perceptual distance between stores and chains (Popkowski et al, 2000)" or "anticipated regret (Lemon et al, 2002)". Furthermore, there exists no general operationalisation (and number of questioned items) of most perception constructs. For example, in the study by Ganesan (1994)

switching costs are measured as "the investments done by the buyer with regard to his/her relationship with the seller", while Jones et al (2000) used three other dimensions to describe the construct and while the same authors (Jones et al, 2002) investigated another 6 dimensions of switching costs in their subsequent research.
In general, and based on Table 5, one can conclude that most perceptual variables have no or a negative impact on churn. In contrast, some authors report “unexpected” findings suggesting e.g. a negative relationship between satisfaction and retention outcomes (e.g. Athanassopoulos, 2000). In conclusion, based on previous retention studies who have mainly investigated the effect of perceptual variables on customer retention, it will be a challenge to enrich perceptual survey data with an unbiased sample of information taken from a data warehouse, to test the impact of all potential predictor categories together into one and the same comprehensive model.

6. Findings

6.1. Churn Behaviour

Figure 2 represents the Kaplan-Meier estimate of the survival curve for all customers included in this study. The plot shows the expected decreasing shape suggesting the fact that the longer an individual has been a bank customer, the smaller his/her probability of survival. In this context, survival means that the customer stays with the company. We remind the reader that (a) factors such as death of the customer (that is, factors uncontrollable to the company) are excluded from the sample, and (b) we observe each individual from the moment he/she became a customer. Figure 2 resembles a step function with two horizontal levels. In general, individuals experience a high switching probability in the early years after becoming a customer. After seven years, the likelihood to stay with the company stabilises for a period of some 15 years. Then, after being 20 years a bank customer, the probability to survive (that is, staying with the company) continues to decrease, the first period of 20 years at a high rate and afterwards at a decreasing rate. When considering retention it is important to know the two ‘critical’ periods in the customers’ lifecycle: the first is situated in the early years after becoming a customer and the second after being a customer for some 20 years.

INSERT FIGURE 2 ABOUT HERE

6.2. Churn Predictors

In this section, we discuss the impact of the observed covariates on retention for all individuals observed in our data set. In order to test the predictors' role on churn behaviour, we also performed an additional model. Besides the basic model, we also investigated a model in which covariates are not allowed to take different values over time. With this extra analysis we have the intention to validate between the impacts of variables that are measured in a time continuous versus a static/discrete time setting. For the latter analysis, we just considered the values on each variable at one static moment, that is on 1 January 2001. This procedure is similar to the one that is often used in studies that only consider the time aspect for the target variables, but not for the independent variables (cf. Table 2, studies for which the methodology for the independent and dependent variables are marked as 'non-time-varying' and 'time + incidence' respectively). The output of the non-time-varying approach resulted in the that fact that almost all estimates became insignificant. Thus, the comparison of both analyses emphasises the need to observe values in a longitudinal setting in order to being able to discriminate between censored and churned people. Due to the improved performance, we only report the results of the model that can take the time-varying nature of the explanatory variables into account.

6.2.1. Robustness Investigation of the Parameter Estimates

As mentioned in Section 4, we have opted to consider different correlation cut-off levels (ranging from .20 to .80) in order to test the stability of the estimated parameter values. The procedure - similar to the one proposed by Mitra and Golder (2002) - starts by analysing the attrition model with a small set of variables and sequentially adding some new variables into the model due to a less restrictive correlation cut-off value. The resulting outcomes of the different correlation cut-offs are presented in Table 6.

INSERT TABLE 6 ABOUT HERE

It is clear from Table 6 that all parameter estimates remain stable until a .40 correlation cut-off; that is, stability of sign, size and significance level. From the moment we are more tolerant towards intercorrelations, and hence allow more variables into the model above the .40 cut-off, some parameter values change substantially. In particular by allowing independent variables to be correlated at the .80 level (and comparing it with the estimates resulting from the more restrictive .70 cut-off), some estimates change enormously in size, such as "Off-line Debit Card ownership" going from 18.523 to 6.962. Moreover, one predictor, Credit Card Ownership, even changes sign. Similar but less dramatic conclusions emerge when going from a .40 cut-off to a less restrictive .50 cut-off, where some variables (e.g. product specific ownership) change in size, and the "merger" variable becomes insignificant although the sign and the size remains more or less constant. Based on these findings we believe that (i) a .80 correlation cut-off is too high a value and (ii) a .40 correlation cut-off probably approaches the optimal correlation cut-off. In summary, we conclude that the results are relatively robust to reasonable levels of multicollinearity.

6.2.2. Parameter Estimates Interpretation

The parameter estimates, along with the hazard rates for each considered correlation cut-off (cf. supra Section 4 and 6.2.1), are given in Table 6. In general, a number of interesting findings emerge from our analysis, such as:

- In terms of demographic characteristics, men experience shorter duration times and older people are less likely to end their relationship with the financial services company;
- Individuals experience higher attrition tendencies in a wealthier macro-economic environment;
- Customer behaviour variables have a limited impact on the customer's switching behaviour, that is, only in terms of the total number of products owned as well as interpurchase time. Therefore, stimulating an 'interactive and continuous' relationships with the customer is of major concern when considering retention.

In the following paragraphs, we discuss these findings in detail, and consider their managerial implications. We have chosen to use the output resulting from the .40 correlation cut-off to interpret the parameter estimates. Additionally, we have also considered the higher correlation levels as a kind of fortification or rephrasing of the conclusions based on the .40 benchmark.

1) *Interpurchase time*. Customers, whose interpurchase times increase, experience shorter duration times. Every additional year in the average interpurchase time is associated with a 4.9 percent (that is, 100(exp(0.04789) – 1)) higher likelihood to churn. This underscores the growing interest to the financial services industry of optimising their cross-selling and up-selling activities.

2) *Total product ownership*. As hypothesised, the more products owned by a customer the more likely he/she is to stay with the company. An increase of one additional product lowers the switching likelihood with 99.9 percent. Considering the investigated data sample, we know that a lot of customers only possess one product due to the nature of the company (that is, being considered as 'secondary banking institute'). For these customers the importance of selling them more products is clear. Both findings concerning the behavioural predictors reveal the strong need to build 'interactive and continuous' relationships with the customers. Especially during the two periods, which are marked as critical during the whole customer lifecycle (cf. Section 6.1), it is highly recommended to develop the customer relationship.

3) *Product-specific ownership, homebanking and phonebanking*. None of these customer behaviour variables were found to have a direct impact on the customer's switching behaviour. Considering this finding in the context of the previous behaviour predictors (that is, interpurchase time and total product ownership), we can conclude that the company needs to develop a customer relationship management (CRM) strategy in which it is the intention to cross- or up-sell that specific product and/or service that is most suitable to enhance each individual customer relationship, and hence not aspiring an a priori product or service selling preference that is intended to be the same for all customers.

4) *Age.* Older people are less inclined to leave the company and individuals who started a relationship with the financial services company at a more advanced age are less likely to end that relationship (that is, 2.2 percent decrease per additional year). As such, one could assume that these results support the findings of Mittal and

Kamakura (2001), that is, older people have more stable preferences and thus, customers with higher ages exhibit lower switching tendencies.

5) *Gender.* Men are at least 141 percent more likely to leave the company than their female counterparts. Possible explanations for our findings can be found in the fact that women are more tolerant than men (Mittal and Kamakura, 2001) or that men may exhibit higher involvement towards banking or bank products. It is interesting for the banking industry to realise that men differ significantly from women when considering retention. In the actual financial services industry communication, a considerably large amount of mailings is only send to the male customers, just because they are considered to be the head of the family. Therefore, it may be recommendable to address both sexes in the communication.

6) *Education level*. More educated people have a somewhat (8.2 %) lower attrition rate. Our results support the findings of Keaveney and Parthasarathy (2001) who assume that customers with higher education levels are more capable of developing sophisticated and probably more accurate estimates of future service performance. Another potential explanation for this finding lies in the nature of the particular financial services company. Experience from this institute's marketing department indicates that most customers consider their bank as a 'second' banking institute. As a consequence we can detect a large group of individuals who became customer by choosing the bank as their secondary institution to do business with. People who decide being a 'multi'-bank customer, need to choose between alternative banking institutions. People who are well educated have the ability to understand the real differences between the possible alternatives and thus are able to choose the one that satisfies best their needs. Thus, their conscious choice is perhaps the reason for the higher likelihood to keep that initial decision and to remain loyal.

7) *Geo-demographic data: Social status.* Customers with a low status have a significantly higher quitting rate than customers who live in an area that is associated with a higher social status. The same argument as used to explain the effect of the 'education level' may be invoked to interpret these findings. People who reside in prosperous areas probably both own more money and decide to invest their capital in more than one banking institution.

8) *Prosperity.* Our results reveal that customers experience higher switching tendencies in a wealthier macro environment. In our study, we defined the 'prosperity index' as the 'GNP per capita' which represents the purchasing power. Higher

purchasing power creates more disposable income after purchasing the same goods and services. This offers on its turn greater room for doing banking activities.

9) *Merger*. The .40 correlation findings reveal that customers who experienced the merger event are less inclined to leave the company. On the other hand, if we consider higher correlation cut-offs, the results suggest that there is no significant impact. Based on these findings, we are cautious regarding the interpretation of this variable. Hence, we are inclined to restrict our conclusion to the fact that the merger at the investigated company had no negative influence on the retention behaviour of their customers. "In-house" ad-hoc studies and expertise from the marketing department confirm that the bank customers tend to have a favourable attitude towards the merger, since the 'new' insurance institute going together with their banking institute is positioned as one of the most important players in the market, and hence strengthens the position of the total company in the industry.

7. Conclusion

In this paper, we focus on churn-incidence modelling for a major European financial services company. We use the Cox proportional hazard method to investigate customer attrition. The technique is appropriate to use because of the time-dependent nature of most covariates and because the basic assumption of proportionality is satisfied. When considering attrition in the financial services industry, two 'critical' churn periods can be identified: the early years after becoming a customer and a second period after being customer for some 20 years. Demographic characteristics and environmental changes are of major concern and have great impact on retention. Behavioural predictors have a limited impact on churn behaviour through the total number of products owned as well as the interpurchase time. Specific product ownership, card ownership, the fact of doing home or phone banking do not affect retention rates. Thus, the 'how many' as well as the 'how recently' behavioural predictors claim the attention. This highlights the importance for financial services companies to stimulate an 'interactive and continuous' relationship, certainly during the early stages of the customer lifecycle. By predicting which customers are most likely to churn, the financial services industry can reduce the churn rates by offering the customers 'new' incentives to stay. In summary, we contribute to the literature by:

(1) combining several different types of predictors into one comprehensive proportional hazard model including several 'new' types of time-varying covariates related to actual customer behaviour; (2) by analysing churn behaviour based on a truly random sample of the total population using longitudinal data.

8. Limitations and Directions for Further Research

Although this study makes some contributions to the knowledge of customer attrition in the context of the financial services industry, some limitations and opportunities for further research deserve to be mentioned.

A limitation of this study and consequently a first point of interest for further analysis concerns the assessment of the four retention predictor categories that appear in literature: customer behaviour, customer perceptions, customer demographics and macro environment. For further research it is a challenge to incorporate them all into one comprehensive retention model. This implies the need to integrate the data obtained from the data warehouses with data collected using surveys. For our study, it is interesting to enrich the available data with some additional variables from the customer perception category. Moreover, it is appealing to put the agent's influencing power and his/her relationship with the customers into perspective.

Second, as stated in this paper, the historical nature of the financial services company might generate specific retention behaviour. The financial services company that provided the data for this study, is often considered as the 'second' banking institute by its customers. Moreover, many customers only possess one specific product (in casu a savings account) due to the historical image as a 'savings' bank. For further investigation of retention behaviour, it would be interesting to test whether different kinds of financial service companies, with a different initial emphasis on customer groups and products, experience the same churn behaviour and antecedents.

Finally, we defined a churned customer as someone who closed all his/her accounts. It is perhaps appealing to push out and to consider (i) 'sleeping' customers - who only have a small amount on one account – as well as churned customers or (ii) to target the event of customers who 'partially' defect instead of a 'total' defection. Another additional aspect to analyse is the churn incidence for one specific high-value generating product, instead of examining the churn on all products.

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Footnotes

Footnote 1
Due to spatial constraints, we do not report the plots in this paper.

Footnote 2
Notice that this variable of the total number of products is not identical to a mere sum of the product ownership indicators, because customers can own more than one instance of the same product.

Table 1: Real-Life Retention Example

Retention Rate (RR)	No. of Customers (thousand) start	2nd year	3th year	4th year	5th year	…	25th year	Average Contribution per year (in Euro)	Total Contribution after 25 years (thousand Euro)	Additional Contribution over 93 % retention situation (thousand Euro)	Additional Contribution over 75 % retention situation (thousand Euro)
75%	1.000	750	563	422	316	…	1	50	174.688	/	0
93%	1.000	930	865	804	748	…	175	50	392.213	0	217.525
94%	1.000	940	884	831	781	…	227	50	419.757	27.544	245.069
100%	1.000	1.000	1.000	1.000	1.000	…	1.000	50	682.518	290.305	507.830

Figure 1: Profit Implications Real-Life Retention Example

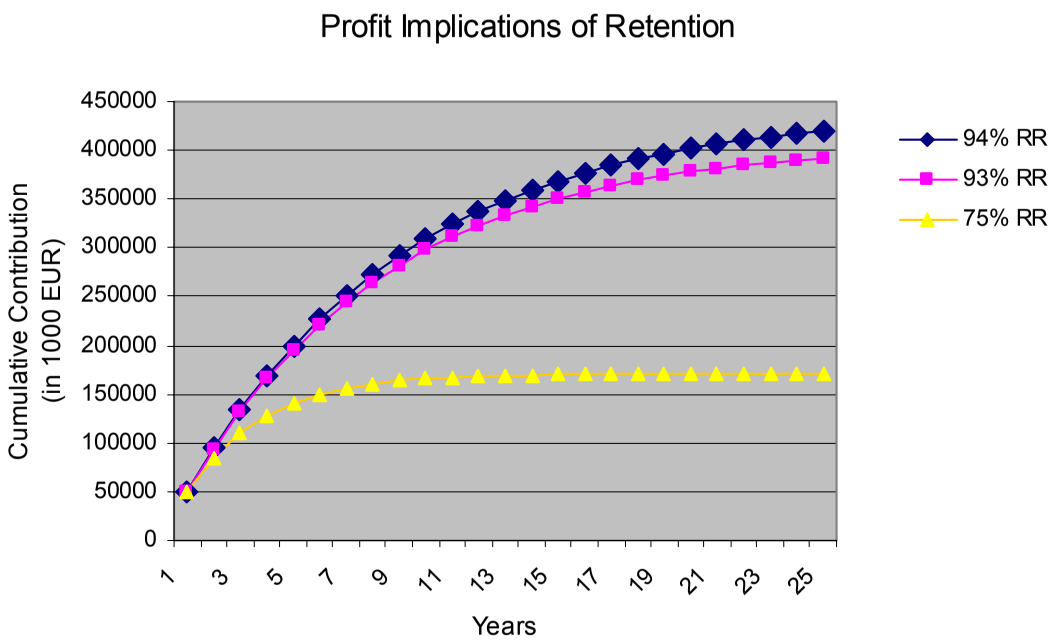

Table 2: Literature Review of Attrition Studies

Reference	Independent Variables				Context				Methodology						
									Dependent Variables		Independent Variables		Data Collection		Technique
	Customer Behaviour	Customer Perceptions	Customer Demographics	Macro Environment	Financial	Retail	Telco	Other	Incidence	Time + Incidence	Non-time-varying	Time-varying	Data Warehouse	Survey	
Static Models															
Athanassopoulos, 2000	x	x	x		x				x		x			x	Logistic regression and qualitative research
Bloemer et al., 1998		x			x				x		x			x	Multivariate regression analysis
Bolton et al., 2000	x	x		x	x				x		x		x	x	Logistic Regression
Clark, 1997		x		x	x				x		x			x	Exploratory research
Colgate and Danaher, 2000		x	x		x				x		x			x	Multivariate regression analysis
Conlon and Murray, 1996		x		x				x	x		x			x	Multivariate analysis of variance and regression analyses
Ganesan, 1994	x	x		x		x			x		x			x	Structural equations modeling
Ganesh et al., 2000		x	x		x				x		x			x	Discriminant analysis
Hitt and Frei, 2002	x				x				x		x		x		T-tests for independent samples
Jones et al., 2000	x	x			x			x	x		x			x	Regression analysis
Jones et al., 2002		x			x			x	x		x			x	Correlation analysis
Keaveney, 1995		x			x	x	x	x	x		x			x	Critical Incident Technique
Keaveney and Parthasarathy, 2001	x	x	x			x			x		x			x	Discriminant analysis
Lemon et al, 2002		x		x		x		x	x		x			x	Logistic regression, Analysis of variance
Levesque and McDougall, 1996	x	x			x				x		x			x	Regression analysis
Maxham, 2001		x						x	x		x			x	T-tests for independent samples and Analysis of variance
Mittal and Kamakura, 2001		x	x					x	x		x			x	Analysis of variance and regression analysis
Mittal and Lasser, 1998		x						x	x		x			x	Chi square statistics and Discriminant analysis
Mols, 1998	x	x			x				x		x			x	Correlation analysis
Mozer et al, 2000	x	x					x		x		x		x		Logistic regression, Decision trees, Neural networks
Nguyen and LeBlanc, 1998		x			x				x		x			x	Structural equations modeling
Paulin et al, 1998		x		x	x				x		x			x	T-tests for independent samples
Varki and Colgate, 2001		x			x				x		x			x	Structural equations modeling
Zeithaml et al, 1996		x			x	x		x	x		x			x	Regression analysis and Analysis of variance
Dynamic Models															
Bhattacharya, 1998	x		x					x		x	x		x		Survival analysis
Bolton, 1998	x	x					x			x	x		x	x	Survival analysis
Dekimpe and Degraeve, 1997	x		x	x				x		x	x			x	Survival analysis
Drew et al, 2001	x		x				x			x	x		x		Artificial Neural Networks
Pohani et al., 1998	x				x					x	x		x		Descriptive analysis
Popkowski et al., 2000		x				x				x	x		x		Hazard model
Vilcassim and Jain, 1991	x		x	x		x				x	x			x	Semi-Markov modeling approach
Weerahandi and Moitra, 1995			x				x			x		x [1]	x		Markovian stochastic model
This Study	x		x	x	x					x		x [2]	x		Survival analysis

[1] The independent variables are measured in a discrete time setting

[2] The independent variables are measured in a continuous time setting

Table 3: Predictors Used in This Study

Predictors	Quantitative	Qualitative	Time-varying	Non-time-varying
Customer Behaviour Predictor Category				
Product-specific ownership				
Current account		x	x	
Savings account		x	x	
Term deposits and pension savings		x	x	
Mortgage		x	x	
Personal loan and tax credit		x	x	
Mutual funds		x	x	
Shares and bonds		x	x	
Total product ownership	x		x	
Card-specific ownership				
Off-line Debit Card		x	x	
Credit Card		x	x	
On-line Debit Card		x	x	
Online Debit /Eurocheque Card		x	x	
Total card ownership	x		x	
Interpurchase time	x		x	
Monetary value	x		x	
Homebanking		x	x	
Phonebanking		x	x	
Customer Demographics Predictor Category				
Age	x		x	
Gender		x		x
Education level	x			x
Social status code				
Elite		x		x
High status		x		x
Medium status		x		x
Social potential code	x			x
Macro Environment Predictor Category				
Merger		x	x	
Prosperity index	x		x	

Table 4: Hypotheses Investigated In This Study

Independent Variables Used in This Study Predictor Category	Explanatory Variable	Supporting Reference(s)	Relationship With Churn
Customer Behaviour	Product-specific ownership	Athanassopoulos, 2000	- and + [1]
		Levesque and McDougall, 1996	0 [2]
	Total number of products	Pohani et al., 1998	-
	Monetary value/Volume	Baesens et al., 2002	- [3]
		Ganesan, 1994	- [4]
	Interpurchase time	Bhattacharya, 1998	+, 0 and - [5]
		Vilcassim and Jain, 1991	+
	Home and phone banking	Hitt and Frei, 2002	-
		Mols, 1998	0 [6]
Customer Demographics	Age (when entering)	Athanassopoulous, 2000	-
		Colgate and Danaher, 2000	+ [7]
		Dekimpe and Degraeve, 1997	-
		Mittal and Kamakura, 2001	-
	Gender (male)	Mittal and Kamakura, 2001	+
		Dekimpe and Degraeve, 1997	-
	Level of education	Colgate and Danaher, 2000	0
		Dekimpe and Degraeve, 1997	0
		Keaveney and Parthasarathy, 2001	-
		Mittal and Kamakura, 2001	+
	Social status and potential (measured by the area of residence)	Mittal and Kamakura, 2001	0
Macro Environment	Prosperity	Bland and Altman, 1998	? [8]
	Merger	Wehner, 2000	+ [9]

[1] Athanassopoulos found that owning loan transactions and time accounts respectively have a positive and negative (siginificant) impact on customer retention

[2] Levesque and McDougall investigated the impact of mortgages and loans on customer retention

[3] This relationship is indirectly derived from a study that suggests a positive relationship between the monetary value and repurchase tendencies

[4] Ganesan investigated the determinants of long-term orientation in channel relationships, in which the retailer is considered as the "buyer", and its supplier as the "seller". He considered two perspectives; the buyer perspective and the seller perspective. For this hypothesis table, only the first perspective is considered.

[5] Bhattacharya investigated three hypotheses with regard to interpurchase/interrenewal times. He found that (i) interrenewal times are - contrary to the postulated hypothesis - negatively associated with churn, (ii) upgrades in interrenewal times (i.e. renewing at a higher level) do not have a significant impact on churn, whereas (iii) downgrades (i.e. renewing at a lowe level) have significant positive effect on churn.

[6] Although Mols interprets the negative correlation sign between using PC banking and the propensity to churn; the sign is marked as non-significant.

[7] Colgate and Danaher investigated the age group of 30 to 49 years old

[8] In their paper Bland and Altman state the problems with regard to long term observational studies: i.e.the survival probablities are assumed to be the same for subjects recruited early and late in the study. We therefore included a macro environment predictor 'prosperity' to account for the environmental situation for each specific duration time.

[9] This relationship is stated by the corresponding author without statistical evidence

Figure 2: Survival Behaviour For All Customers

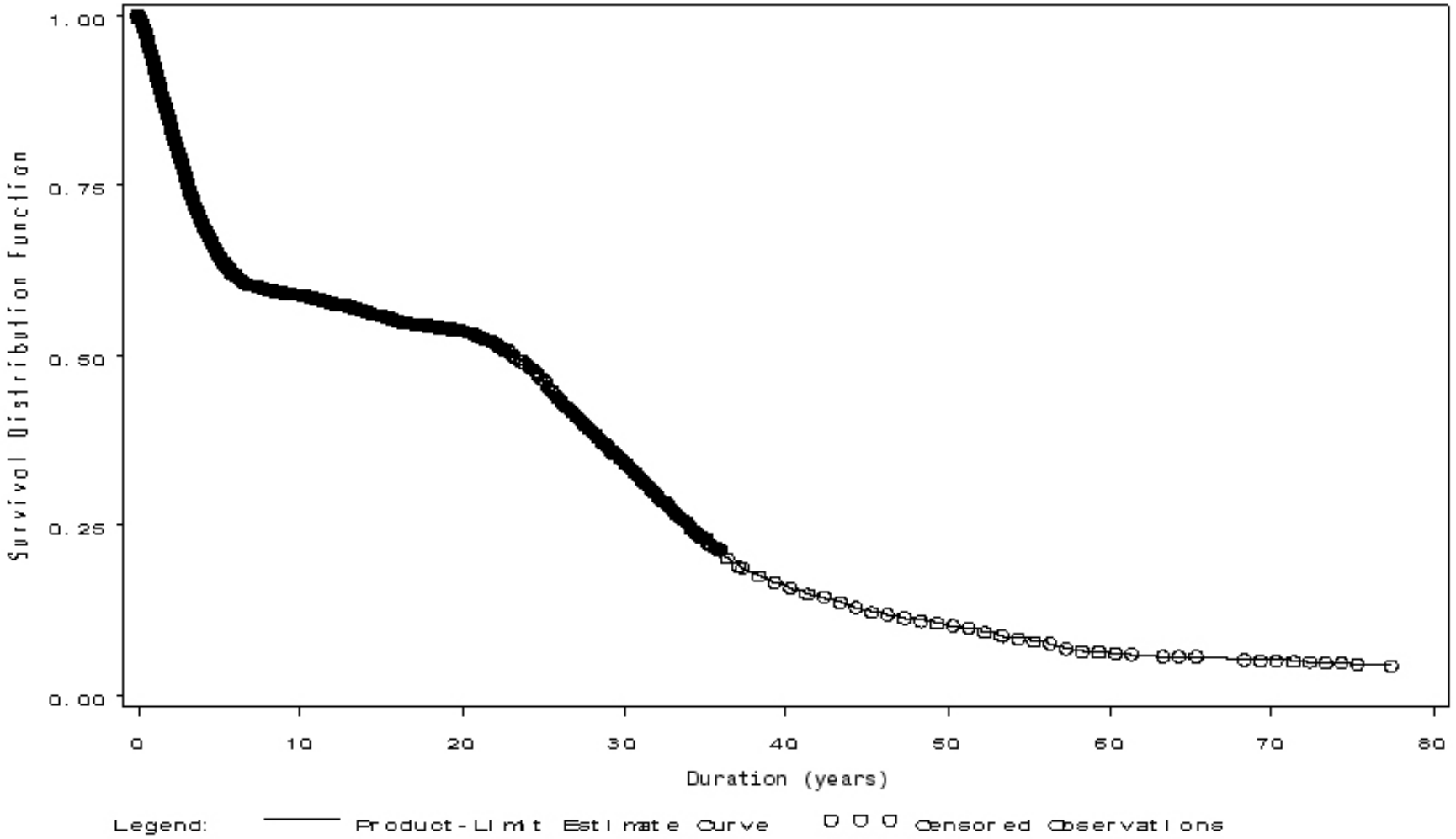

Table 5: Customer Perception Variables and Dimensions

Customer Perception Variables/Dimensions	Supporting Reference(s)	Relationship With Churn
Overall satisfaction	Bloemer et al, 1998	-
	Keaveney and Parthasarathy, 2001	-
	Lemon et al, 2002	- and 0
	Mittal and Kamakura, 2001	-
	Mittal and Lasser, 1998	- and 0
	Mols, 1998	-
	Nguyen and LeBlanc, 1998	-
	Paulin et al, 1998	-
	Varki and Colgate, 2001	- and 0
(Core) Service quality	Athanassopoulos, 2000	- and + [1]
	Bloemer et al, 1998	- and 0
	Clark, 1997	-
	Colgate and Danaher, 2000	-
	Ganesh et al, 2000 [2]	0
	Jones et al, 2000	-
	Jones et al, 2002	-
	Keaveney, 1995	-
	Levesque and McDougall, 1996	- and 0
	Mittal and Lasser, 1998	- and 0
	Nguyen and LeBlanc, 1998	0
	Paulin et al, 1998	- and 0
	Varki and Colgate, 2001	-
	Zeithaml et al, 1996	-
Relational performance	Athanassopoulos, 2000	- and + [3]
	Bolton, 1998	-
	Colgate and Danaher, 2000	- and 0
	Ganesan, 1994	-
	Ganesh et al, 2000 [2]	+ [4]
	Jones et al, 2002	-
	Keaveney, 1995	-
	Levesque and McDougall, 1996	0
	Paulin et al, 1998	- and 0
Problem (service failure) experience	Maxham, 2001	+ and 0
	Zeithaml et al, 1996	+
Satisfaction with problem recovery	Conlon and Murray, 1996	- and 0
	Keaveney, 1995	-
	Levesque and McDougall, 1996	0
	Maxham, 2001	-
	Zeithaml et al, 1996	-
Pricing / cost conditions	Athanassopoulos, 2000	- and + [5]
	Colgate and Danaher, 2000	-
	Ganesh et al, 2000 [2]	0
	Keaveney, 1995	-
	Varki and Colgate, 2001	- and 0
Intentions	Bolton et al, 2000	-
	Ganesh et al, 2000 [2]	- and + [6]
	Lemon et al, 2002	-
	Mols, 1998	- and + [7]
Perceived switching costs	Ganesan, 1994	-
	Jones et al, 2000	- and 0
	Jones et al, 2002	-
	Mols, 1998	0
Company versus competitors performance	Bolton et al, 2000	- and 0
	Keaveney, 1995	-
	Levesque and McDougall, 1996	0
Image / reputation	Bloemer et al, 1998	- and 0
	Ganesan, 1994	-
	Nguyen and LeBlanc, 1998	-
Locational convenience	Athanassopoulos, 2000	-
	Ganesh et al, 2000 [2]	0
	Keaveney, 1995	-
Anticipated regret	Lemon et al, 2002	-
Ethical problems	Keaveney, 1995	-
Customer's perception of being dependent on the vendor	Ganesan, 1994	-
Customer's perception of the vendor as being dependent on the customer	Ganesan, 1994	+
Perceptual distance between stores	Popkowski et al, 2000	-
Trust	Ganesan, 1994	- and 0

[1] The positive sign refers to the predictor "innovativeness".

[2] In their study, Ganesh et al, focussed on "switched to" firms and not on "switch from" firm. They distinguished three groups of customers in their discriminant analyses: stayers (G1), dissatisfied switchers (G2) and satisfied switchers (G3). Satisfied switchers refer to customers who defect due to uncontrollable reasons of defection, whereas dissatisfied switchers refer to controllable reasons of defection. The predictors are meausered for the current firm; i.e. in case of switchers, this means the "switched to" firm. For this table we only consider G1 and G2.

[3] The positive sign refers to the predictor "physical and staff service".

[4] The positive sign refers to the predictor "people factor".

[5] The positive sign refers to the predictor "pricing conditions".

[6] The positive sign refers to the predictor "active loyalty".

[7] The positive sign refers to the predictors "intentions to complain if problems occur" and "switching intentions based on price sensitivity".

Table 6: Parameter Estimates and Hazard Rates of the Attrition Model

Predictors	Results of the Attrition Models													
	correlation cut-off = **.20**		correlation cut-off = **.30**		correlation cut-off = **.40**		correlation cut-off = **.50**		correlation cut-off = **.60**		correlation cut-off = **.70**		correlation cut-off = **.80**	
	Estimate	Hazard Rate	Estimate	Hazard Rate	Estimate	Hazard Rate	Estimate	Hazard Rate	Estimate	Hazard Rate	Estimate	Hazard Rate	Estimate	Hazard Rate
Customer Behaviour Predictor Category														
Product-specific ownership														
Current account	X		-15.532		-14.866		-20.245		-20.536		-22.440		-21.218	
Savings account	X		X		X		-20.265		-20.164		-25.187		-24.262	
Term deposits and pension savings	-12.685		-14.512		-14.163		-21.009		-21.680		-24.603		-23.630	
Mortgage	-10.807		-11.301		-9.721		-14.105		-14.505		-16.045		-15.132	
Personal loan and tax credit	-12.997		-16.098		-15.468		-23.995		-25.098		-25.277		-24.317	
Mutual funds	X		-10.972		-10.769		-17.162		-17.735		-19.087		-18.124	
Shares and bonds	X		X		X		X		-13.291		-16.919		-16.015	
Total product ownership	-7.083 *	0.001	-6.814 *	0.001	-6.856 *	0.001	-2.490 *	0.083	-2.214 *	0.109	-2.163 *	0.115	-2.163 *	0.115
Card-specific ownership														
Off-line Debit Card	X		X		X		X		17.691		18.523		6.962	
Credit Card	X		X		X		X		X		2.488		-8.368	
On-line Debit Card	X		X		X		X		-3.510		-3.036		-13.358	
Online Debit /Eurocheque Card	X		X		X		X		X		X		-11.567	
Total card ownership	X		X		X		-14.799		-13.018		-12.886		-1.618	
Interpurchase time	X		X		0.048 *	1.049	0.046 *	1.047	0.046 *	1.047	0.049 *	1.050	0.049 *	1.050
Interpurchase time missing value (time until 2nd purchase)	X		X		X		X		X		0.060 *	1.062	0.060 *	1.062
Monetary value	X		X		X		X		X		X		X	
Homebanking	-16.864		-17.980		-16.926		-15.974		-16.503		-17.403		-16.522	
Phonebanking	-17.886		-19.329		-17.352		-16.869		-16.727		-16.497		-15.727	
Customer Demographics Predictor Category														
Age	-0.022 *	0.978	-0.021 *	0.979	-0.022 *	0.978	-0.016 *	0.984	-0.016 *	0.984	-0.016 *	0.984	-0.016 *	0.984
Age missing value	X		X		X		X		X		X		X	
Gender	0.858 *	2.358	0.853 *	2.346	0.879 *	2.408	0.685 *	1.983	0.683 *	1.980	0.691 *	1.997	0.691 *	1.997
Gender missing value	0.511 *	1.666	0.567 *	1.764	0.565 *	1.759	0.524 *	1.689	0.523 *	1.688	0.516 *	1.675	0.51607 *	1.675
Education level	-0.052 **	0.949	-0.080 **	0.924	-0.085 **	0.918	-0.076 **	0.927	-0.076 **	0.927	-0.081 **	0.992	-0.081 **	0.922
Education level missing value	1.030 *	2.801	0.986 *	2.680	0.963 *	2.620	1.109 *	3.033	1.115 *	3.049	1.119 *	3.062	1.119 *	3.062
Social status code														
Elite	X		-0.451 *	0.637	-0.498 *	0.608	-0.627 **	0.534	-0.630 *	0.533	-0.482 *	0.617	-0.482 *	0.617
High status	-0.503 *	0.605	-0.586 *	0.557	-0.593 *	0.553	-0.664 *	0.515	-0.664 *	0.515	-0.529 *	0.589	-0.529 *	0.589
Medium status	X		X		X		-0.094 **	0.910	-0.097 **	0.908	-0.029		-0.029	
Social status code missing value	-0.041 ***	0.960	-0.122 *	0.885	-0.116 *	0.890	-0.258 *	0.773	-0.261 *	0.771	-0.803 *	0.448	-0.803 *	0.448
Social potential code	X		X		0.013		0.004		0.004		0.004		0.004	
Social potential code missing value	X		X		X		X		X		0.683 *	1.980	0.683 *	1.980
Macro Environment Predictor Category														
Merger	X		X		-0.235 *	0.791	-0.014		-0.014		-0.021		-0.021	
Prosperity index	0.007 *	1.007	0.007 *	1.007	0.008 *	1.008	0.007 *	1.007	0.007 *	1.007	0.007 *	1.007	0.007 *	1.007

* significant at <0.0001
** significant at 0.05
*** significant at 0.10
X predictor is not investigated due to the correlation cut-off

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