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Possible Applications of Survival Analysis in Franchising Research

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ABSTRACT *Time is an important variable for retailers. The concepts of survival and duration, linked to this time variable, can be very interesting in franchising research. For instance, what are the determinants of the survival of a network or a store? Which elements decrease the period before franchising or internationalising a network? There is a well adapted but little-exploited methodology in this research area: survival analysis. Consequently, this methodological paper presents in detail survival analysis methodology before giving relevant examples of applications in the franchising field. Managerial implications of these kinds of research are given before the conclusion.*

KEY WORDS: Franchising, survival, duration, survival analysis

Introduction

Retailing and service stores are more and more organised within networks in an increasing number of sectors and countries. Within this network organisation, they can better expand and react to competitors. Indeed, in this present environment characterised by wide competition, retailers are not only concerned by development and performance but also by survival. Many consulting guides try to present the best options to ensure a good retail survival. For instance, 50 strategies, tips and secrets for a retail survival can be found on http://www.insigniasystems.com/isig/pdfs/RetailSurvivalGuide.pdf. It deals with daily valuable tips to help a store to stay competitive such as: "The purpose of a sign is service to the customer. Are you giving your customers the service they demand?" "Don't lie. Write facts, not fiction. 'Amazing' is overused." This every day advice is helpful but what about going further in these determinants of survival? The concept of survival is central to the retailing topics and can be studied in various ways. In this paper, we focus our attention on the franchising area. Indeed, it can deal with the survival of a network, the survival of a store, the survival of a relationship between franchisor and franchisee, i.e. franchisee turnover. The term "survival" implies the notion of

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time, of duration. Time, like location, is really a main task for the retailers. A good location is very important but good time management is essential. Some relevant durations can be analysed: the durations before internationalisation, before franchising, before location, before franchisee choice, etc.

One particular methodology is well adapted to these interesting research tracks: survival analysis. This statistical method, initially implemented in medical research, is little exploited in retailing/franchising fields but presents some attractive perspectives. This paper focuses therefore on the presentation of possible applications of survival analysis to franchising research.

This methodological paper is divided into two sections. The first one presents in detail the survival analysis methodology with its principles, main concepts, models and conditions of use and limitations. The second section shows some possible applications of survival analysis methodology. Some references to past research papers and some new study perspectives are given. For each case, the possible determinants of survival or time duration are quoted. Managerial implications of these kinds of research are given before concluding and indicating the limitations of this paper and some directions for future research.

The Principles of Survival Analysis

For more than 60 years, social sciences have been interested in studying behavioural changes of individuals over time. We can observe these changes in mutually exclusive and exhaustive states for units such as individuals, organisations and products (Peters & Sheridan, 1988). Some examples of applications can be counted in economics and business. For instance, organisational behaviourists have studied processes of changing jobs, getting a promotion, being laid off, retiring, employee turnover (Allison, 1984; Darden, Hampton & Boatwright, 1987; Lee *et al*. 1992; Sheridan, 1992; Fournier, 2000, 2001). Organisational mortality (Staber, 1992; Chen & Lee, 1993), store durations (Star and Massel, 1981; Dekimpe & Morrison, 1991), franchised network survival (Shane, 1996, 1998a; Shane & Spell, 1998b; Shane & Foo, 1999; Cliquet & Perrigot, 2002), stability of international joint ventures (Blodgett, 1992), predicting illegal corporate behaviour (Baucus & Near, 1991; Hill *et al*., 1992), cash management as a strategic resource (Russo, 1991), brand loyalty in marketing (Duwors & Haines, 1990), are also some of the management topics using survival analysis. Demographers have been interested in births, marriages, divorces, migration patterns and deaths (Pollard *et al*., 1981). Crimes, convictions, arrests and rehabilitations have been studied by criminologists (Allison, 1984). Engineers have studied time during which a motor runs before failing (Steinburg & Colla, 1988). Biochemists and bio-statisticians have analysed mortality rates, aging and chronic diseases (Elandt-Johnson & Johnson, 1980).

Survival analysis examines the hazard that a certain event occurs (Elandt-Johnson & Johnson, 1980). Survival analysis possesses two main aims (Melnyk *et al*., 1995). On the one hand, we want to estimate the time period during which the event can happen. On the other hand, we want to examine and describe the time distribution of the event, and estimate quantitatively the impact of various independent factors, called covariates, on this distribution. Data collection essentially consists of a longitudinal record of events which happen to individuals, organisations, etc. (Darden *et al.*, 1987).

The Main Concepts of Survival Analysis

The Event

In order to better understand survival analysis, we must first explain the concept of the event. Formally defined, an event is "a change in state as defined by one or more qualitative variables within some observation period and within the relevant state space" (Blossfeld, Hamerle & Mayer, 1989). It consists of some form of change in state (Melnyk *et al.*, 1995). According to Allison (1984), qualitative changes can be identified as events if there is a "relatively sharp disjunction between what precedes and what follows" the change over a period of time. For instance, an event can be a store opening, a store failure, a job termination, etc. Three questions can be asked: 1. Did the event happen? 2. When did it happen? and, 3. How do various factors affect the occurrence and the timing of the event?

The Measurement Window

The measurement window characterises the period of time during which the researcher makes their observation. The choice of the measurement window length in the different investigations is a personal and arbitrary judgement by the researcher. Indeed, there is little theoretical and empirical evidence to use as a guide (Peters & Sheridan, 1988). Throughout various research papers about organisations, patients, employees, etc., we notice that window lengths are very different: studies can be carried out over three or four months or even longer periods up to several years. Due to the arbitrary aspect of length choice, we must not forget that results can vary consequently with the length of the observation period. This variability in the results can be observed in various works about turnover (Darden, Hampton & Boatwright, 1987; Peters & Sheridan, 1988; Hoverstad, Moncrief & Lucas, 1990; Fournier, 2000, 2001). In addition to this diversity in the results, studies are also very difficult to compare.

The Censorship

Censored duration. In many fields and mainly in business research/management sciences, we often possess data composed of duration between two events. For instance, it can deal with the interval separating two purchases, employee job duration within a firm and the duration of a firm. But sometimes, this duration is censored: it has not been completely observed. The censorship refers to an incomplete survival time (Li, 1995–1996) like the lack of start date (left censorship), the lack of ending date of the event (right censorship) or the loss of a customer, his (or her) disappearance from the sample within the measurement window (right censorship). The term "censored" means that we ignore the exact length of the duration, because we do not know the initial event date of this duration and/or the final event date. We have said that censored data are data which are incomplete. But in order to be complete, the information must meet three conditions (Melnyk *et al*., 1995): 1. The time during which the subject is exposed to a particular risk type must be specified; 2. We must be able to identify the end of the period; and 3. The end must be due to some event under investigation. These three conditions cannot always be satisfied. The process is sometimes terminated due to reasons different from these under investigation. We can also have occasionally both right and left censored data. The censorship represents one of the major difficulties in processing data with traditional statistical techniques. Survival analysis seems to be a good way to work on these kinds of studies.

Right censorship. Right censorship indicates the fact that we cannot determine the final date of the period separating the two events studied (Ray, 1988). This unknown date can be close, distant or even non-existent. When data are right censored, there is a starting time but no ending point, because the process has not yet ended (Melnyk *et al*., 1995). For instance, right-censored data are present when some firms are still present in the market, or some stores are still open at the end of the measurement window. More generally, data are right censored when the event never occurs or occurs after the ending date of the measurement window.

Left censorship. Left censorship indicates the fact that we cannot determine the initial date of the event studied, for instance the date of acquisition of a product for people asked about their purchase (Ray, 1988). We can have data for which there is an ending point, but no information about when the subject was first exposed to risk (Melnyk *et al*., 1995). Data are left censored if the initial date of the event is unknown or prior to the measurement window.

The Survival Analysis Methodology

The core of the survival analysis methodology is given below. We will first introduce some basic definitions. Two main concepts: the survival function and the hazard function are dealt with by the methodology. Most modern methods are mainly non-parametric (Kaplan-Meier, 1958) or semi-parametric (the Cox model, 1972). When no covariate is available in the data, Kaplan-Meier methods can be used, otherwise the Cox model is the solution.

Some Preliminary Definitions

The survival function. The survival function reflects the cumulative survival probabilities throughout time. In other words, it is the rate of units, individuals, organisations, etc. not yet reached, at time t, by the event studied. When we study events, the dependent variable is frequently the length of time until the event. The survival function is the unconditional probability that an event has not yet occurred at the period of time t. If one notes $S(t)$, this survival function, we have:

$$S(t) = Prob(T \geqslant t) = 1 - F(t) = 1 - Prob\ (T < t) = 1 - \int_0^t f(u)du^1$$

where *F(t)* is the cumulative distribution function of the variable *T*, i.e. the probability of the event occurrence between *0* and *t*.

The hazard function. For a better understanding of the proportional hazard models, two key concepts must be introduced (Darden, Hampton & Boatwright, 1987). The first one is the concept of set at risk, which is the set of units, individuals, organisations, employees, etc. in the sample, which are at risk regarding the event occurring at a certain point in time. For instance, at the first period of time (day, week, month, year), the set of units of the sample is at risk. The second key concept is the hazard rate. It is the conditional probability for an event to occur to a unit of the sample at a specific time since the unit is at risk. If one notes *h(t)* this hazard rate, then it can be written:

$$h(t) = \lim_{dt \to 0} \frac{\text{Prob}(t \leqslant T \leqslant t + dt/T \geqslant t)}{dt} = \frac{f(t)}{S(t)} = -\frac{S'(t)}{S(t)}{}^2$$

The non-parametric estimator of Kaplan-Meier (1958)[3]. The non-parametric methods are a good way to make the first exploratory analysis, because there is no particular hypothesis about the hazard rate shape (Blossfeld, Hamerle & Mayer, 1989). To determine if there are differences between the various groups, distinct survival functions are estimated for each group. This method gives the probability of being still survivor for a patient, or still present in the market for a firm, or still opened for a store, after t days, weeks, months, years, etc., if:

$$Qj = Prob\ (T \geqslant j/T \geqslant j - 1)$$

And, q_j its estimator, then:

$$S(t) = Qt \cdot Qt\text{-}1. \ldots .Q1$$

and

$$\hat{S}(t) = q_t \cdot q_{t\text{-}1}\ . \ldots .q_1{}^4$$

If n_j = number of individuals still surviving, or firms still in the market, or stores still opened just before j and m_j = number of events observed at j (death for individuals, disappearance for firms, closing for stores), then:

$$q_j = (n_j - m_j)/n_j$$

The Cox model (1972). The Cox model is a multiple regression procedure in which the explanatory variables x_i have values for each units (individual, firm, store, etc.) at the date of its appearance into the measurement window. These covariates, either qualitative or quantitative, are time independent or even time dependent[5]. The dependent variable is the time duration, for instance: the survival of a network, the duration of a contract, etc. The Cox model enables the observation of the instantaneous hazard of the event occurrence in relation to time t and the explanatory variables.

The instantaneous hazard is the conditional probability for an event to occur to a unit of the sample at a specific time t since the event has not yet occurred before this time t. Proportional hazard model enables the simultaneous consideration of several covariates to explain survival without using a parametrical version of the survival functions. This model is written as follows:

$$\lambda(t, Z) = \lambda_0(t).c(\beta, Z)^6 \textit{ where } \beta' = (\beta_1, \ \dots\ , \beta_p \textit{ and } Z' = (X_1, \ \dots\ , X_p)$$

It represents the relationship between the instantaneous death (or disappearance or closing) hazard and the covariates. The ratio of the instantaneous hazards[7] of two units whose respective features are

$$(x_1, \ \dots\ , x_p)$$

and,

$$(x'_1, \ \dots\ , x'_p) \textit{ is :}$$

$$\frac{\lambda(t, x_1, \ \dots\ , xp)}{\lambda(t, x'_1, \ \dots\ , x'_p} = \exp\left(\sum_{j=1}^{P} [\beta_j \, \mathrm{x}_j - \beta'_j \, \mathrm{x}'_j]\right)$$

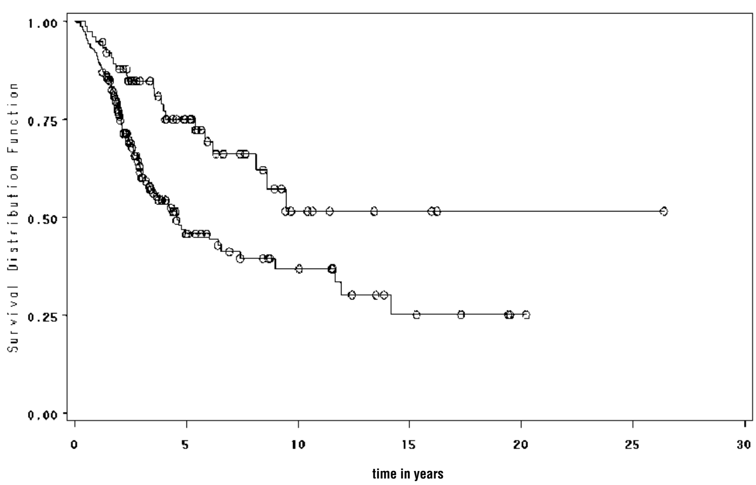

Figure 1. An example of Kaplan-Meier curves

The Cox model consists in the following choice:

$$c(\beta, Z) = exp(\beta' Z)$$

in order to have a positive hazard function without any constraints on the coefficient values. The Cox model therefore represents λ(t,Z) as follows:

$$\lambda(t, x_1, \ \dots \ , x_p) = \lambda_0(t).\exp\left(\sum_{j=1}^{p} \beta_{\mathrm{j}} \ \mathrm{x_j}\right)$$

And the ratio of the instantaneous hazards is:

$$\frac{\lambda(t, x_1, \dots, x_p)}{\lambda(t, x'_1, \dots, x'_p)} = \frac{C\big((\beta_1, \dots, \beta_p); \ (x_1, \dots x_p)\big)}{C\big((\beta'_1, \dots, \beta'_p); \ (x'_1, \dots, x'_p)\big)}$$

This formula produces some comments. First, the instantaneous hazard can be separated into two multiplicative parts of which one depends on time t and the other on the variables. Second, and still more important, the Cox model enables the classification of profiles at risk. Indeed, determining $\beta' Z$ allows us to classify the units according to their increasing propensity of failure (death, disappearance, closing) and constitute therefore some groups at identical risks, i.e. all the units with the same value of $\beta' Z$.

The Conditions of use and Limits of Survival Analysis

Some Data Constraints

Survival analysis can be used for each problem involving events (Melnyk *et al.*, 1995). There are four characteristics associated with data for which survival analysis is particularly well adapted. First, dependent variables vary over time. Second, dependent variables are not supposed to be normally and independently distributed or identically distributed. Third, censorship is not a problem. Fourth, data collection is longitudinal.

Some Difficulties Encountered

Problems for social sciences researchers. One of the main difficulties encountered in applying duration models for business researchers is that these techniques are essentially presented in the statistics literature, which stems from various traditions and fields. Consequently, we notice a wide diversity in terminology and techniques used.

Problems linked to the study of the events. Researchers in operations management have been particularly interested in some aspects of the events. They have focused on two characteristics linked to the events, mean and variance. These characteristics have often been studied from a cross sectional perspective. Even though data are collected over time, they are transformed into cross sectional data. This emphasis on cross sectional studies does not give all the insights which can be found by survival analysis with regard to event distributions.

Problems linked to observation window. The problem related to the observation window concerns the interpretation of study results, which can vary with the length of the observation window chosen for the analysis. The window can be too short, or inversely too long, to properly interpret the results.

Problems of censorship. On the one hand, problems linked to right censorship involve problems of internal validity. We do not know whether results of one particular study could be the same, if the dependent variable representing the status would have been evaluated at a different ending date. We can make the same observation for left censorship. On the other hand, even though survival analysis seems to have been built to process censorship problems, we notice very little literature about this phenomenon. It remains difficult to understand how each method processes censored cases; at best, a complex formula is given without any explanation and without any comparison to the other methods (Ray, 1988). Moreover, result sensibility to the rate of censored cases is studied nowhere with theoretical indicators; and no threshold, beyond which the duration would be too often censored for result reliability, seems to be proposed (Ray, 1988).

Some Examples of Survival Analysis Applications in Franchising Research

Some researchers have studied the concept of survival in the franchising area. Shane (1996, 1998), Shane and Spell (1998), Shane and Foo (1999) worked on survival, mortality and success (using survival analysis methodology), Stanworth *et al*. (1998) studied failure rates, Bates (1995a, 1995b, 1998) analysed the survival rates Lafontaine and Shaw (1999) focused on the franchising activity and survival in the United States of America during the period 1980–1992, and Falbe and Welsh (1998) examined the perception of the franchisors regarding franchisee success and failure. The survival analysis methodology can be implemented in several other ways. We will now indicate some of these directions related to franchising topics.

Network Survival

The purpose of such a study would be in finding the determinants of franchised network survival. Some research papers have identified size as one of the determinants (Shane & Foo 1999; Perrigot, 2002a, Perrigot & Cliquet, 2003). Indeed, the larger the network is, the more it is a survivor. Age also appears as one of the variables favouring network survival (Shane & Foo, 1999). Greater age will decrease the probability of failure. The managerial form seems to be a survival determinant as well. Plural form networks present a propensity for having a better survival time than predominantly franchised networks or predominantly company-owned networks (Cliquet & Perrigot, 2002; Perrigot 2002b, 2003). Some other variables can be also taken into account. For instance, it can deal with nationality (Perrigot & Cliquet, 2003), external certification (Shane & Foo, 1999), etc. A Kaplan-Meier analysis would enable the differences of survival times between two groups or more to be seen, constituted according to one variable (big networks vs. small ones, old networks vs. young ones, etc.). The weights of the various covariates able to explain the network survival could appear through a Cox model.

Store Survival

The aim of such an analysis would be to determine the variables able to explain the survival time of a retailing or service store. Indeed, which factors cause one store to survive when another one fails? Some controllable variables can be envisaged such as kind of business: ''rates of survival are highest for corporations, intermediate for partnerships, and lowest for proprietorships'' (Star & Massel, 1981), store size: ''the larger the size of the retail business, the higher the rate of survival'' (Star & Massel, 1981), store location: ''the greater the degree of urbanisation, the lower the rate of retail business survival'' (Star & Massel, 1981), number of employees, number of days or hours open per week, etc. Some other variables are not controllable such as number of competitors, economic situation of the region, currency value of the products sold at retail: ''retailers dealing in 'big ticket' products have a higher rate of survival than retailers dealing in 'small ticket' products'' (Star and Massel, 1981). It can be interesting to observe the store durations within a same network (Dekimpe & Morrison, 1991). For instance, the units can be ranked according to their managerial form and one research question can consist in knowing if company-owned units present a propensity for having a longer survival time than franchised units within a same network. The Kaplan-Meier estimator could be used in this aim. If we wanted to test the impact of the various possible explanatory variables, we would introduce all of them in a Cox model to see the weight of each variable in the store survival, or inversely, in the store failure.

Franchisee Turnover (Duration of the Franchisee/Franchisor Relationship)

The purpose of this work would consist in determining the explanatory variables of the franchising contract termination. Indeed, some franchisees can choose to stop or not renew their contract. It can also stem from the franchisor who chooses to not renew the contract with a franchisee who, for instance, does not respect the brand concept and breaks the homogeneity in the brand image. There are consequently two kinds of variables which can explain this contract end, and by extension, the franchisee turnover. The first one concerns the franchisee themself, their age, financial situation, business income, personal situation, point of view about the future of their town, etc. The second one deals with the franchisor themself: their financial situation (they can want to buy the franchised unit to transform it into a company-owned unit and keep the profit for themself (Oxenfeldt & Kelly, 1968–1969)), wish for concept respect (Manolis, Dahlstrom and Nygaard, 1995), managerial strategy, etc. Consequently, the Kaplan-Meier estimator could be implemented in order to test the differences between two or more groups of franchisees (young ones vs. old ones, etc.), or two or more groups of franchisors (need for a strong control of the concept vs. no need for a strong control of the concept, etc.). Then, the Cox model could also be applied to study the simultaneous impact and weight of all these explanatory variables on the franchisee turnover.

Duration Before Franchising Internationalisation

The aim of this possible study would be to determine the variables able to explain the differences between the time periods before internationalisation. Using the competitive theory of the firm literature, Huszagh *et al.* (1992) found that age (time in operation), size (number of units), and, to a lesser extent, equity capital and headquarters location, are significant factors differentiating between domestic and international franchisors. The resource-based explanation of international franchising suggests that before deciding to internationalise, firms must gain a sufficient amount of resources such as financial capital, brand name recognition, and managerial and routine-processing know-how. As the franchising firm grows, it develops additional franchised units, which allow it to acquire the resources necessary for expanding overseas. As such, the franchising firm's size, age, rate of growth were often used as measures of the amount of resources the franchising firm possesses. The more resources the franchising firm has, the more likely it seeks for international expansion. Consequently, the Kaplan-Meier estimator could be implemented to test the differences between two groups of franchise networks. These two groups could be, for instance, formed according to their size (big firms vs. small firms), their age (old firms vs. young firms), their rate of growth (fast growing firms vs. slow growing firms). We could test if one of these variables has an impact on the time period before internationalisation. The Cox model could also be applied in order to study the simultaneous impact of these explanatory variables on the time period before internationalisation.

Duration/Experience Before Franchising

The purpose of this analysis would consist in finding the variables able to explain the differences between the time periods before franchising. The concept must be well managed, the know-how must be excellent before deciding to franchise a store concept. It seems that this experience allows the creation of a perennial franchised network. This experience can be reflected by different variables such as age (number of years since the first store opening), size (number of stores yet opened), human resources management (number of employees). A Kaplan-Meier could therefore test the difference of the franchising timing along two groups of firms. For instance, for groups elaborated according to their age, we can test if old firms having more experience in the business, are more likely to franchise their concept than young firms with less experience. A Cox model could go further, mixing several independent variables and observing their relative weights to explain the time period before franchising.

Duration Before Site Selection (Store Location Choice)

The aim of this research would concern the determination of the explanatory variables of the differences between the time periods before that the franchisor selects a site. Location speed is important for the network development and success (Lafontaine, 1992). Which of the environmental variables: number of inhabitants in the town, number of competitors in the town, available store area, etc. can explain these differences of time periods? A Cox model could improve the results given by a Kaplan-Meier estimator, by determining the weight of the different explanatory variables. The theme of spatial strategies is very important for all the network operators. Indeed, like time, location is one of the keys of the business success. The choice of the company-owned store location, and the time necessary to open it, are determinants for the results of the store, and by extension, the results of the network even if "multiunit site selection models have long ignored the impact of time delays in store openings" (Kaufmann, Donthu and Brooks, 2000).

Duration Before the Franchisee Choice by the Franchisor

The purpose of this work would consist in observing if some variables could explain the differences in the time periods before the franchisor chooses his franchisee. Indeed, the time before the franchising contract is signed by both franchisor and franchises can vary. Many variables can explain this heterogeneity in time. They can be divided into two groups. The first one deals with the franchisee themself: their know-how in the activity sector, competencies, money, personal investment in the business, etc. The second one deals with the environment. Location is an important criterion to accept a new franchisee and thus, to open a new store. Potential customers, competitors, etc. could be some other explanations. A Kaplan-Meier model could allow to see if the franchising contract is signed faster in the case of experienced businessmen than in the case of individuals having less (or no) experience. A Cox model could improve these results by the integration of several explanatory variables into the model. We could study which kinds of variables have more impact on the time period before signing a contract: variables about the franchisee or environmental variables.

Duration Before Multi-Store Openings in the Case of Multi-Franchise

The aim of this study would be to find the variables explaining the different time periods between two store openings in the case of multi-franchise (Kaufmann & Dant, 1996). Indeed, multi-franchise is more and more used in network development. For the franchisor, it seems easier to give the opportunity to open a new store to a franchisee already well known than to a new franchisee. The franchisor is sure that the routine, the know-how, the concept, the brand image are yet well managed. In many sectors, and particularly in the hotel industry, a same franchisee can possess several units. But, what determines the time period between the opening, by a same franchisee, of the *n*th store and the $(n + 1)$th store? A Cox model could improve the results given by the Kaplan-Meier estimator with the introduction of several covariates such as the number of units yet possessed, the distance between the two stores, etc. This consideration could increase the speed of the network development.

Managerial Implications

On the one hand, a focus on the concept of survival allows managers to take into account the explanatory variables of survival. For instance, if it is shown that size reduces the probability to fail, managers will have to focus on business development in terms of size in order to ensure the business's long-term survival. These comments concern the franchisor, the franchisee, the store manager, etc. As far as contract durations are concerned, the features characterising a long-term contract could be well analysed by the practitioners before signing the contract in order to ensure a long-term relationship and all the advantages linked to this one. On the other hand, if we focus on time duration before franchising, before internationalising, before choosing a location or a franchisee, or before opening a new store in the case of multi-franchise, the aim will be to make this period as short as possible. The emergence of the variables explaining this duration allows the manager to consider these variables carefully. With these studies, the variables explaining the survival or the relatively short period before an event, consequently the business success, emerge and appear very important for the manager.

Survival analyses have some limits because first of all they cannot be as predictive as other methods or models. But most of the time, failures are due to catastrophe phenomena and these methods or models are not adapted. Using the catastrophe theory seems then to be adequate but very difficult to implement (Thom, 1972). Moreover, failure should be detected as soon as possible. That is the reason why efficiency analysis can also be developed in order to improve failure prediction.

Conclusions

The purpose of this paper was to present the survival analysis methodology in order to show its adequacy to study all the survival and duration topics in franchising research. The detailed presentation, in the first section, allows us to understand the principles of use of this technique. The second section, which illustrates several possible applications of survival analysis to franchising field goes further in the understanding of this methodology and gives some ideas for future research. Of course, this paper has some limitations. We want to confirm that this paper is from a methodological/technical perspective. The possible applications given in section two are not exhaustive. It is hoped that these first ideas will cause some other and new applications. All the potential determinants of survival must be studied. Of course, age and size are the two most common ones but the others such as nationality, location, managerial form, etc. must be analysed and belong to future research directions. The concept of survival can also be developed further. Indeed, network survival can be, for instance, divided into two features: the resistance to the environment and the efficiency. Here, network survival is both knowing how to manage the environment: competitors, legal situation, economical situation, etc., and knowing how to manage the costs: a resources allocation optimisation (Cliquet & Perrigot, 2003). These traits can also be considered.

Notes

1. $S(t)$ is a monotonic decreasing function such as $S(0) = 1$ and $S(1) = 0$.
2. Therefore, we have: $S(t) = exp(-\int_0^t h(u)du)$.
3. We can mention that the survival curve estimation by the actuarial method (Böhmer, 1912) is quite similar to the Kaplan-Meier methodology. Indeed, the Qj are estimated for time intervals *a priori* fastened and not time intervals determined by the dates of the events. In general, intervals chosen are the month, the semester, the year, etc. We notice that this actuarial method appeared before the Kaplan-Meier estimator.
4. We notice that when we compute $\hat{S}(t)$, only the dates at which some events are observed are taken into account. $\hat{S}$ is a constant between two times at which an event occurs.
5. Here, in this section, we only focus on time independent covariates.
6. $c(\beta,Z\ )$ depends on the features of the unit Z.
7. This ratio does not depend on time and these kinds of models are called proportional hazards models.

References

Allison, P. (1984) *Event History Analysis: Regression and Longitudinal Data* (Beverly Hills: Sage Publications).

Bates, T. (1995a) A Comparison of franchise and independent small business survival rates, *Small Business Economics*, 7(5), pp. 377–388.

Bates, T. (1995b) Analysis of survival rates among franchise and independent small business startups, *Journal of Small Business Management*, 33(2), pp. 23–36.

Bates, T. (1998) Survival patterns among newcomers to franchising, *Journal of Business Venturing*, 13(2), pp. 113–130.

Baucus, M. S. & Near, J. P. (1991) Can illegal corporate behavior be predicted? An event history analysis, *Academy of Management Journal*, 34(1), pp. 9–36.

Blodgett, L. L. (1992) Research notes and communications factors in the instability of international joint ventures: an event history analysis, *Strategic Management Journal*, 13(6), pp. 475–481.

Blossfeld, H. P., Hamerle, A. & Mayer, K. U. (1989) *Event History Analysis* (Hillsdale, NJ: Lawrence Erlbaum).

Böhmer, P.E. (1912) Theorie de unabhängigen Wahrscheinlichkeiten, *Rapports, Mémoires et Procès Verbaux du Septième Congrès International d'Actuaires*.

Chen, K. C. W. & Lee, C. H. J. (1993) Financial ratios and corporate endurance: a case of the oil and gas industry, *Contemporary Accounting Research*, 9(2), pp. 667–694.

Cliquet, G. & Perrigot, R. (2002) An application of survival analysis to the French hotel networks, in: *Proceedings of the 16th Annual International Society of Franchising Conference*, *February 8–10* (Orlando, USA).

Cliquet, G. & Perrigot, R. (2003) The efficiency of French franchised hotel chains: a DEA application, in: *Proceedings of the 17th Annual Conference of International Society Of Franchising, February 15–16* (San Antonio, USA).

Cox, D. R. (1972) Regression models and life-tables (with discussion), *Journal of the Royal Statistical Society*, B (34), pp. 187–200.

Darden, W. R., Hampton, R. D. & Boatwright, E. W. (1987) Investing retail employee turnover: an application of survival analysis, *Journal of Retailing*, 63(1), pp. 69–88.

Dekimpe, M. G. & Morrison, D. G. (1991) A modeling framework for analyzing retail store durations, *Journal of Retailing*, 67(1), pp. 68–92.

Duwors, R. E. Jr. & Haines, G. H. Jr. (1990) Event history analysis measures of brand loyalty, *Journal of Marketing Research*, 27(4), pp. 485–493.

Elandt-Johnson, R. C. & Johnson, N. L. (1980) *Survival Models and Data Analysis* (New York: Wiley).

Falbe, C. M. & Welsh, D. H. (1998) NAFTA and Franchising: A Comparison of franchisor perceptions of characteristics associated with franchise success and failure in Canada, Mexico and the United States, *Journal of Business Venturing*, 13, pp. 151–171.

Fournier, C. (2000) La rotation du personnel des centres d'appels : une etude exploratoire, *Actes du Séminaire International Eric Langeard de Recherche en Management des Activités de Service*, pp. 265–276.

Fournier, C. (2001) Etude des départs volontaires du personnel en contact dans les centres d'appels, *Actes du 17ème Congrès International de l'Association Française de Marketing*, CD-ROM.

Hill, C. W. L., Kelley, P. C., Agle, B. R., Hitt, M. & Hoskisson, R.E. (1992) An empirical examination of the causes of corporate wrongdoing in the United States, *Human Relations*, 45(10), pp. 1055–1076.

Hoverstad, R., Moncrief, W. C. III and Lucas, G. H. Jr. (1990) The use of survival analysis to examine sales force turnover of part-time and full-time sales employees, *International Journal of Research in Marketing*, 7, pp. 109–119.

Huszagh, S. M., Huszagh, F. W. & McIntyre, F. (1992) International franchising in the context of competitive strategy and the theory of the firm, *International Marketing Review*, 9(5/6), pp. 5–18.

Kaplan, E. L. & Meier, P. (1958) Nonparametric estimation from incomplete observations, *Journal of the American Statistical Association*, 153(282), pp. 457–481.

Kaufmann, P. J. & Dant, R. (1996) Multi-unit franchising: growth and management issues, *Journal of Business Venturing*, 11(5), pp. 343–358.

Kaufmann, P. J., Donthu, N. & Brooks, C. M. (2000) Multi-unit retail site selection processes: incorporating opening delays and unidentified competition, *Journal of Retailing*, 76(1), pp. 113–127.

Lafontaine, F. (1992) How and why do franchisors do what they do; a survey report, in: P.J Kaufmann (Ed) *Franchising Passport for Growth and World Opportunity*, (Proceedings of the Society of Franchising, Lincoln, NE: University of Nebraska).

Lafontaine, F. & Shane, K. (1998) Franchising growth and franchisor entry and exit in the U.S. Market: myth and reality, *Journal of Business Venturing*, 13(2), pp. 95–112.

Lee, T. W., Ashford, S. J., Walsh, J. P. & Mowday, R. (1992) Commitment propensity, organizational commitment, and voluntary turnover: a longitudinal study of organizational entry process, *Journal of Management*, 18(1), pp. 15–32.

Li, S. (1995–1996) Survival analysis, *Marketing Research*, 7(4), pp. 17–23.

Manolis, C., Dahlstrom, R. & Nygaard, A. (1995) A preliminary investigation of ownership conversions in franchised distribution systems, *Journal of Applied Business Research*, 11(2), pp. 1–8.

Melnyk, S. A., Pagell, M., Jorae, G. & Sharpe, A. S. (1995) Applying survival analysis to operations management: analyzing the differences in donor classes in the blood donation process, *Journal of Operations Management*, 13, pp. 339–356.

Oxenfeldt, A. R. & Kelly, A. O. (1968–1969) Will successful franchise systems eventually become wholly-owned chains?, *Journal of Retailing*, 44, pp. 69–83.

Perrigot, R. (2002a) L'importance de la taille dans la survie organisationnelle: Une application aux réseaux de franchise, *Actes de la 7ème Journée de Recherche en Marketing de Bourgogne,* 13 novembre *(Distribution, Achat, Consommation*, Dijon).

Perrigot, R. (2002b) La pluralité des formes statutaires au sein d'un réseau de points de vente: une application à la survie des chaînes de pizzas en France entre 1987 et 2001, *Sciences de Gestion et Pratiques Managériales*, V. Giard Ed., Economica.

Perrigot, R. (2003) Mixité et survie : une étude des réseaux de franchise présents en France entre 1982 et 2001, *Actes du 19ème Congrès International de l'Association Française de Marketing, 9–10 mai* (Gammarth, Tunisie).

Perrigot, R. & Cliquet, G. (2003) Survival analysis along a hotel chain classification in France, influence of network managerial form and nationality on the fall in the classification, in: D. Welsh & I. Alon (Eds) International Franchising in Developed Markets: Western and Northern Europe.Washington D.C.: CCH Publisher) pp. 227–256.

Peters, L. H. & Sheridan, J. E. (1988) Turnover research methodology: a critique of traditional designs and a suggested survival model alternative, *Research in Personnel and Human Resources Management*, 6, pp. 231–262.

Pollard, A. H., Yusaf, F. and Pollard, G. N. (1981) *Demographic Techniques*, Sidney: Pergamon.

Ray, J-C. (1988) Données censurées et modèles de durées, *Recherche et Applications en Marketing*, 3(2), pp. 77–88.

Russo, M. V. (1991) The multidivisional structure as an enabling device: a longitudinal study, *Academy of Management Journal*, 34(3), pp. 718–733.

Shane, S. (1996) Hybrid organizational arrangements and their implications for firm growth and survival: a study of new franchisors, *The Academy of Management Journal*, 39(1), pp. 216–234.

Shane, S. (1998) Making new franchise systems work, *Strategic Management Journal,* 19(7), pp. 697–707.

Shane, S. & Spell, C. (1998b) Factors for new franchise success, *Sloan Management Review*, 39(3), pp. 43–50.

Shane, S. & Foo, M. D. (1999) New firm survival: institutional explanations for new franchisor mortality, *Management Science*, 45(2), pp. 142–159.

Sheridan, J. E. (1992) Organizational culture and employee retention, *Academy of Management Journal*, 35(5), pp. 1036–1056.

Staber, U. H. (1992) Organizational interdependence and organizational mortality in the cooperative sector: A community ecology perspective, *Human Relations*, 45(11), pp. 1191–1212.

Stanworth, J., Purdy, D., Price, S. & Zafiris, N. (1998) Franchise versus conventional small business failure rates in the US and UK: more similarities than differences, *International Small Business Journal*, 16(3), pp. 56–69.

Star, A. D. & Massel, M. D. (1981) Survival Rates for Retailers, *Journal of Retailing*, 157(2), pp. 87–99.

Steinburg, D. & Colla, P. (1988) *Survival Analysis: A Supplementary Module for SYSTAT, SYSTAT*, Inc. (Evanston, IL).

Thom, R. (1972) *Structural Stability and Morphogenesis* (W. A. Benjamin Inc.).