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ANALYSIS OF THE IMPACT OF THE PERCEPTION OF THE QUALITY OF CAR INSURANCE SERVICE ON THE ACT OF TERMINATION INITIATED BY POLICYHOLDERS ON EXPIRY

ANALYSE DE L'IMPACT DE LA PERCEPTION DE LA QUALITÉ DU SERVICE D'ASSURANCE AUTOMOBILE SUR L'ACTE DE RÉSILIATION INITIÉ PAR LES ASSURÉS À L'ÉCHÉANCE

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Abstract

Actuarial calculations and probabilistic analyses of insurance operations have proven over time to be caught between retention, multiple risk exposures and most importantly massive changes in customer behaviour. Nowadays, customers are much more vigilant and expect a lot from their insurers and it is recognized today that the analysis of their behaviour is certainly a primordial matter in decision making, being one of the main challenges taken up by insurance companies in order to promise and establish their sustainability in the long run. This article will attempt to analyse the impact of direct (the insured's perception of the quality of the insurance service offered) and indirect (the involvement of the insured, the commitment of the provider to its insured, the cost of changing the insurer, and the alternatives in the insurance market) determinants on the act of cancelling motor insurance contracts initiated by the insured at the end of the contract in the Rabat area. The study will use a sample of 550 policyholders and will employ generalized linear models, more specifically, binary logistic regression.

Keywords: « Car insurance », « termination act », « prediction models », « generalized linear models », « binary logistic regression ».

Résumé

Les calculs actuariels et les analyses probabilistes des opérations d'assurance se sont avérées au fil du temps, coincées entre recherche de fidélisation, expositions à des risques multiples et plus principalement à des changements massifs dans le comportement des clients. Actuellement, les clients sont beaucoup plus vigilants et attendent beaucoup de leurs assureurs et est reconnu aujourd'hui que l'analyse de leurs comportements est assurément une affaire primordiale dans la prise de décision, étant l'un des principaux défis relevés par les compagnies d'assurances afin de promettre et instaurer leur durabilité à longue échéance. Cet article, tentera d'analyser l'incidence des déterminants directs (la perception de l'assuré de la qualité de service d'assurance offerte) et indirects (l'implication des assurés, l'engagement du prestataire à l'égard de ses assurés, le coût de changement de l'assureur, et les alternatives du marché d'assurance) sur l'acte de résiliation des contrats d'assurance automobile initié par les assurés à l'échéance dans la zone de Rabat. La réalisation de cette étude utilisera un échantillon de 550 assurés et mobilisera les modèles linéaires généralisés, plus spécifiquement, la régression logistique binaire.

Mots-clés : « Assurance automobile », « acte de résiliation », « modèles de prédiction », « modèles linéaires généralisés », « régression logistique binaire ».

Introduction

Contract termination is a notion frequently evoked in different fields of action and is guided by the major concerns of managers to preserve the survival of the units they manage. The termination of a contract is by definition an act in which the contract loses its entity and reaches a point where it no longer conceives of rights. It is extinguished when all the obligations provided during its lifetime have been fully fulfilled by the parties involved. In fact, for the sake of simplicity, we can state that the common practice of termination in motor insurance is to end a contractual commitment entered into within a predetermined period at its expiry, on the assumption that within this period, the situation would not be likely to change for the better. However, it is possible that during the life of the contract, a reason may arise that triggers the termination of the contract. This explanation of the decision to terminate indicates that this concept cannot be understood solely on the part of the insured, but also by the decision of the insurers. The policyholder will not voluntarily terminate his insurance contract with his insurer if the insurer has good reasons for canceling before the end of the contract period, which we believe is very reasonable given the very attractive prospects offered by other insurance companies.

Several works have been developed around this question, for example, (Matthias Ruefenacht's 2018) study focused on the role of satisfaction and retention for insurers as key drivers of insurance company stability. Alternatively, (Ranganathan Venkatesan & Jayanth Jacob 2019) asked whether loyalty and satisfaction promote customer retention in the life insurance industry. It has been shown that a satisfied customer has a good, stable, and continuous business relationship but also tends to recommend the entity to others. Furthermore, they have shown through the structural equation model that provides a high-quality service influences the satisfaction of existing customers. Also, the american perspective considers that service quality depends on the characteristics or attributes of the service that are explicitly associated with the services offered (Abaaoukide K., 2018). The article by (Montserrat Guillen and al., 2008) "The need to monitor customer loyalty and business risk in the European insurance sector" also helps to explain the importance of rigorous monitoring of customer loyalty to avoid policy terminations. However, under certain specific conditions, it has been shown that although a customer may be satisfied with the service provided by the target company, they may be equally satisfied with other offers. Thus, instead of considering satisfaction as an antecedent of customer loyalty, it should nevertheless be considered as a variable that induces a certain

commitment behavior and that at any time the customer would be led to terminate the contract if a fierce event during the relationship occurs.

Although research on retention and retention strategies has helped to better understand the relationship between the insurer and its insured, except that work on the breakdown of contractual relationships has started to create its field of research. The results of (Manuel Leiria and al., 2020) 'Non-life insurance cancellation: a systematic and quantitative review of the literature' suggest the extent to which some important factors may explain changes in customer behavior in non-life insurance. By facilitating the understanding of the act of canceling insurance contracts, it enables insurance companies to develop measures that seek to retain customers at a significant level of return, while yielding better profits for the insurance companies. Other studies, such as those of (Christophe Dutang 2012), further examine the effect of linkages and interactions between the insured, the insurer, and the market. He finds that the insurance premium variable can be a decisive factor for the insured to renew or not renew his car insurance contract with his current insurance company. Alternatively, (Leo Guelman 2014) follows the same perspective as the latter. He points out that the higher the insurance premium, the more likely it is that the policyholder will leave the institution, in contrast to a lower insurance premium. This clearly shows the sensitivity of policyholders to changes in insurance rates in deciding whether or not to renew the contract at the end of its term. (Montserrat Guillén Estany and al., 2003) have addressed the issue of explaining customer default and propose the use of logistic regression models to predict and understand why customers leave an insurance company. In addition, there is a large body of literature on the study of contractual termination and customer abandonment in various fields, including work that has studied employer-initiated termination of employment contracts, termination of contractual relationships between companies, termination of contracts with suppliers, and others.

The concern of insurance companies regarding the cancellation of insurance contracts is increasing significantly. For several years, the attitudes and behaviors of Moroccan policyholders have shown an increased sensitivity to the subject, which is why our work, concerning the prediction of the churn decision and the analysis of the impact of the factors stimulating the act of canceling motor insurance contracts, presents a unique feature for insurance companies. Two elements should be highlighted at the outset. Firstly, the decision to carry out this work made it possible to demonstrate that the act of cancellation involves

determinants that precipitate the break and play a role as an immediate trigger of the intention to cancel. Also, this test attempts to predict whether changes will be made to the churn history that is taken into consideration when assessing the rate at which customers leave their usual insurance companies and switch to others. Secondly, it turns out that acquiring new customers is more expensive than keeping old ones. Therefore, they are not only trying to understand how to make them satisfied with the service provided but also to understand what can drive them away. In addition, to understand the causes that make them cancel their insurance contract. However, by focusing on the different determinants that directly and indirectly impact the policyholder's switching decision towards his insurance company, the latter will be able to classify those policyholders that make up its customer portfolio according to the risk they generate for the entity. This measure can be used to facilitate the quantification of risks by examining those that most influence the act of termination.

In this article, we simply answer the following question: **What would be the impact of direct and indirect churn determinants on the act of termination of car insurance policies at the end of their contracts ?** In other words, we choose to analyse specifically the impact of a poor perception of the quality of insurance services offered to policyholders on their decision to change their usual insurer. Within the same framework, we will try to analyse the impact of a set of indirect determinants on this decision to change. This study was conducted within a post-positivist epistemological paradigm, using hypothetico-deductive reasoning. However, the methodological posture refers to the use of qualitative methods, consisting of collecting and selecting the determinants used in the study, and quantitative methods, allowing the use of binary logistic regression to quantify the impact of the failure of the quality of the services offered (direct determinant) by insurers on the decision to change the current provider. Similarly, to assess the impact of indirect determinants on the act of cancelling car insurance contracts by policyholders. The study will be conducted in four phases, starting with a literature review covering the perception of service quality, provider commitment, customer involvement, the cost of switching, and the alternatives available in the market. Secondly, to explain the mathematical model used to quantify the impact of the explanatory variables on the response variable. Then, to detail the different results obtained by the SPSS software (23) in the form of an assortment of tables. Finally, an analysis and discussion of the results of this survey.

1. Direct determinant of the act of termination: Perceived quality of service

In contrast to tangible goods, the judgment of the quality of services only takes place after the service has been provided, implying a reaction from the consumer which is an indispensable component in the construction of the service offered. In other words, the intangibility of the service hinders a posteriori quality control by the providers. In this context, it is important to orient the policy of service providers towards the socio-cultural foundations in terms of the perception of quality by users. Since the term "quality" means the ability of a product to satisfy the needs of users or also conformity to requirements (Association Française de Normalisation (AFNOR)), the notion of quality perception is much deeper. It represents an overall judgment or subjective assessment by the consumer of the superiority or excellence of any product (Valerie A. Zeithaml, and al. 1988). However, perceived quality is an individual's data which is a function of the learning and experience he has acquired. V. A. Zeithaml et al. argue that it is derived from a comparison between what the customer considers the service offered by a company to be and his perceptions of the performance of that organization.

According to (Albert Caruana 2002), the majority of explanations of perceived service quality revolve around the idea that it is the result of the customer's comparison between their expectations and their perceptions of how the service was performed. In other words, it highlights the difference between the consumer's expectations of service performance and their perceptions of the service received. In other words, it is a comparison between what consumers believe the service offered by a firm should be and their perceptions of the performance of the providers of these services. It follows that the perception of quality is expressed globally and is always relative. This conception of perceived service quality makes it possible to identify various characteristics of this notion: service quality is subjective (it is the result of a judgment), cognitive (it corresponds to an evaluation), and relative (it is evaluated in relation to a reference base) (Grégory Bressolles 2001). In summary, service quality is derived from the customer's perceptions **(**BIKOH. R., and al. 2021). These perceptions depend on the customer's personality and other situational variables and significantly affect the consumer's purchase or redemption decisions.

The deficiency of service quality was one of the research topics of the professor of relationship marketing (Christian Grönroos 1990). This quality deficiency was explained and developed in his book "Service Management and Marketing". Grönroos C. explains that the concept of service quality is split into two dimensions, namely, functional quality, which refers to how, how, and where the delivery takes place, and technical quality, which refers to what is delivered

to the customers. This driver for change has led to a set of temptations for the creation of a scale to measure consumer perceptions of service quality. The widely-used measurement scale is the one proposed by (Parasuman A. and al., 1988), in their work "SERVQUAL: a multiple-item scale for measuring consumer perceptions of service quality", where they explain that this measurement scale "provides a basic picture of perceived service quality by being designed in a dual expectation/perception format around statements structured in five service quality dimensions". The five dimensions proposed by this scale are tangibility, reliability, responsiveness, assurance, and empathy. However, various authors, such as (Cronin J. & Taylor S. 1992), challenge the notion of 'quality' about the "SERVQUAL" model, and instead use the term 'satisfaction'. In the same context, (Nha Nguyen 1990), in his essay "An explanatory model of service quality evaluation: an empirical study", explains that "the merit of this model lies in its attempt to deepen the concept of perceived quality by providing a structure of relationships, which encompasses both various components of quality and a range of its explanatory factors. Nevertheless, the model ignores the logical relationships between these factors as they are part of a larger system called the servicing system".

On the other hand, (Brady M., and Cronin J. 2001), criticize this "SERVQUAL" measurement scale and present an alternative, attributing three dimensions (the subject of our study) to the quality of service perceived by the prospect: the quality of the results, the quality of the interaction and the physical environment. Outcome quality refers to the object of the transaction, i.e. what the customer gets at the end of the production process, interaction quality refers to the quality of the contact between the consumer and the service provider, and physical environment quality refers to the conditions and circumstances in which the service is provided. (Keaveney S. M. 1995), advises in his role, that the customer voluntarily leaves the relationship with his provider because they are dissatisfied with the perceived quality or also the quality of the interaction. Also, the works of (Berry L. 1995), (Kelley S. W., & Davis M. A. 1994), notify that a failure in the interrelationship between the organization and the customer influences the behavior of the latter in case of poor service perception. The works of (Hess R. L., Ganesan S. & Klein N. M. 2003) and (Bell S. J., Auh S. & Smalley K. 2005), have explained that sustained quality is a means of strengthening the interrelationship between the customer and his or her service provider, while poor quality precipitates change as reported in the writings of (Cronin J. & Taylor S. 1992). In the same vein, (Bansal H. S. and al., 2005) add that poor service quality, or a degraded change in the level of service quality, triggers a change in the ability of consumers

to relate to their supplier and probably in their behavior. Based on this, we propose the following hypotheses :

- **H 1: Clients' poor perception of service quality is positively correlated with their intention to dissolve the relationship with the regular provider.**

- H 1.1: Clients' poor perception of the quality of service outcomes is positively correlated with their intention to dissolve the relationship with the regular provider.

- H 1.2: Clients' poor perception of the quality of service interactions is positively correlated with their intention to dissolve the relationship with the regular provider.

- H 1.3: Clients' poor perception of the physical service environment is positively correlated with their intention to dissolve the relationship with the regular provider.

2. Indirect determinants of switching

2.1.Customer involvement

This notion has been widely discussed in the work of several theorists, particularly in the field of food. The ascending sequence of its works was marked by the works of (Pliner P., & Hobden K. 1992), (Juhl H. J., & Poulsen C. S. 2000), (Olsen S. O. 2001), (Bell R. & Marshall D. W. 2003), and (Verbeke W. & Vackier I. 2004). It has been understood by researchers as a factor that can have a significant impact on the consumer decision process. In other words, the notion of involvement is a predictive and explanatory variable for the behavior of prospects about a product or service offered by their provider.

The term involvement has given rise to several controversies regarding its definition. (Sood J. H. & Zaîchkowsky J. L. 1987), define this term as "the importance perceived by an individual or the interest granted to an aspect of his universe". However, the definition that has received consensus from the majority of authors is that of (Rothschild Michael L. & Michael J. Houston 1984), where they explain that involvement "is an unobservable state of motivation, excitement or interest. It is created by a specific object or situation. It leads to behaviors: certain forms of product search, information processing, and decision making". In the same vein, (Goldsmith R. E., & Emmert J. 1991), add that consumer involvement is a "sense of interest and enthusiasm that consumers have for product categories". Furthermore, (Ben Miled-Chérif 2001) explains the state of involvement as "the intensity, direction, and nature of the consumer's interest in an object". (Rothschild Michael L. & Michael J. Houston 1984) come back to subdivide this conception into two kinds. The first is enduring involvement, expressing a long-term interest in a category of products or services while being independent of the influence of the exchange

context. The second is situational involvement, which reveals a temporary attachment and interest by the consumer in a specific kind of product or service. Other authors such as (Park C. W. & Young S.M. 1983) through their writings "A Theory of Involvement and brand attitude Formation" and "Consumer Response to Television Commercials: The Impact of Involvement and Background Music on Brand Attitude Formation" have subdivided involvement into two dimensions, cognitive and affective. The cognitive dimension of involvement is essentially related to the utility and rationality that the consumer experiences in the process of choosing a product or service.

Whereas low involvement is synonymous with the low intention to seek and process information, as discussed in the writings of (Zaîchowsky J. L. 1984). The affective dimension of involvement, also called "emotional" or "expressive" is related to the capacity and intensity of arousal of the consumer object as reported by (Dhar R. & Wertenbroch K. 2000). This implication stems from the hedonic needs that the product or service is intended to satisfy. While symbolic needs are related to the feeling of belonging to a group, or a specific category. From these two dimensions, it can be seen that the customer often seeks to consume a product or service that satisfies utilitarian, sensory, emotional, and symbolic needs. The concept of involvement is, therefore, a process of a behavioral nature initiated by the individual while being ready to trigger reactions to external or internal stimuli, using research and analysis of the information collected to make the final purchase decision.

In another attempt to define the concept of involvement, (Warrington P. & Shim S. 2000), state that involvement refers to an internal state of arousal, comprising three dimensions, namely, "intensity of involvement" referring to the degree of the consumer's motivation, "direction of involvement" reflecting the object producing the motivation; and "persistence of involvement" referring to the duration of the intensity of the latter. (Warrington P. & Shim S. 2000) add that highly involved consumers react more strongly to changes in provider behavior. This idea is strongly supported by (Gordon M. E., and al., 1998) who suggest that highly engaged prospects are likely to appreciate the company's overall direction and actions. In the same vein, (Richins M. L. & Bloch P. H. 1991), in turn, explain that high intensity of customer commitment reveals high levels of satisfaction or dissatisfaction, correlating with the purchasing situations encountered. Furthermore, the work of (Oliva T. A., and al., 1992) and the works of (Pritchard M. P., and al., 1999), show that a high-level of consumer involvement implies satisfaction, brand loyalty, positive commitment to the supplier's strategies, and tolerance of the latter's failings. On the other hand, we can also add that a highly involved or firmly committed

consumer may have a stronger intention to leave the relationship than a relatively less involved one, due to the perceived quality of the service. From the above, the following hypothesis can be extracted :

- **H 2: The more strongly the consumer is involved, the stronger the positive effect of a perceived low service quality on the intention to change provider.**

- H 2.1: *A high degree of knowledge of the products consumed implies a high sensitivity to perceived quality failures, and increases the likelihood of switching to another provider.*

- H 2.2: *A high degree of affection for the provider implies a high sensitivity to perceived quality failures and increases the likelihood of switching to the usual provider.*

2.2.The cost of changing the service provider

The term "switching cost" was first introduced by the German economist Carl Christian Von Weizsäcker in his book "The Costs of Substitution" published in 1984, to designate the cost borne by the prospect after the decision to change his service provider. This concept has undergone many changes both theoretically and empirically. There are many works dealing with the cost of change in different sectors of activity, such as the work of (Gravielle H. & Masiero G. 2000), in the pharmaceutical field, the work of (Kim M., Kliger D., & Vale B. 2003) in the banking sector, the writings of (Knittel C. 1997) in telecommunications, and the essays by (Sturluson J. T. 2002) ; (Giulietti M., and al., 2003); and (Loomis D. & Malm E. 2000) in the energy field.

(Jones M., Mothersbaugh D., & Beatty S., 2000) define switching costs as “perceived economic and psychological costs associated with a change of alternative”. However, N.E.R.A. (2003) (National Economic Research Associates) also defines switching costs as "real or perceived costs that occur when a customer switches suppliers and that they would not incur if they stayed with their usual supplier". The writings of (Burnham A., and al., 2003), as well as the essays of (Wathne K., and al., 2001), make it clear that switching costs are defined as costs that customers associate with the process of switching providers. The work of (Jones M., Mothersbaugh D., & Beatty S., 2000), has made it possible to extract different families of switching costs, revealing at this level the multidimensional nature of switching costs. The first family refers to the costs of breaking away from the provider and groups together two types of change costs, namely, the cost of loss of performance and the cost of uncertainty. Loss of performance costs corresponds to the disappearance of the advantages linked to the correlation between the customer and his usual supplier.

(Burnham A., and al., 2003), in their book "Consumer switching cost: a typology, antecedents, and Consequences", attempt to classify switching costs into three varieties. "Firstly, switching costs are the costs that are incurred when a customer changes his or her behavior, and secondly, switching costs are the costs that are incurred when a customer changes his or her behavior, and thirdly, the costs that are incurred when a customer changes his or her behavior. First, switching costs include the costs of economic risks and the costs of evaluating and assessing the products and services of new suppliers, which are caused by the time and effort spent on switching. Secondly, the financial costs, agglomerate the loss of financial and emotional benefits and privileges offered to customers by their former provider after they intended to replace it. Finally, the costs of relational change refer to psychological rather than economic costs. The severing of personal ties with the former brand and the loss of a previously conceived identity implies a psychological and emotional toll on the prospect, clearly summarising the costs of relational substitution. (Wathne K., and al., 2001) explain that switching costs represent a real barrier to consumers switching from their provider to another alternative. (Burnham A., and al., 2003) add that a perception of switching costs at the time of switching implies that customers maintain their relationship with their usual provider. Apart from low switching costs, prospects' dissatisfaction with the failure of the service quality offered at high prices, or low organizational commitment, implies a strong switching tendency. Some work by authors such as (Burnham A., and al., 2003), (Jones M., and al., 2000), (Oliva T. A., and al., 1992), and (Sharma N. & Patterson P. G. 2000), have shown that the cost of switching providers is a moderating variable, negatively affecting the correlation between satisfaction and willingness to stay in the relationship. That is, a high switching cost can reduce the intention to switch, despite the dissatisfaction of the customer and vice versa. In this context, we propose the following hypothesis :

- **H 3: The higher the switching costs, the weaker the positive effect of perceived poor service quality on the intention to switch.**

H 3.1*: High switching costs (the loss of previous benefits, and the risk of making a wrong choice), imply a decrease in sensitivity to perceived quality failures, and a decrease in the chances of switching to a regular provider.*

H 3.2*: High learning costs (search cost + cost of adapting to the new insurer), imply a decrease in sensitivity to perceived quality failures, and decrease the likelihood of switching to the usual provider.*

H 3.3*: High fixed costs (time and effort to consolidate a new relationship) imply a decrease in sensitivity to perceived quality failures, and decrease the likelihood of switching to a new provider.*

2.3.The attractiveness of alternatives

(Caprapo A., and al., 2003) explain that true knowledge of the competition, and the best alternatives offered by a market, is a sufficient preliminary to orient consumer intentions towards a decision to repurchase or to substitute the usual provider. (Sharma N. & Patterson P. G. 2000), on the other hand, have already touched on the same subject in previous works, confirming the presence of a positive correlation between the knowledge of favorable alternatives as a moderating variable and the intention experienced by the customer to change or keep his daily supplier. On the other hand, the writings of (Caprapo A., and al., 2003) as well as the essays by (Bansal H. S., and al., 2005), report that there is a direct effect between awareness of other alternatives and the attractive possibilities offered by industry and the prospect's intention to switch or remain in the relationship. (Jones M., Mothersbaugh D., & Beatty S., 2000), come back once again to confirm all of the reflections presented by the other authors, advising that an awareness of the prerogatives presented by the alternatives or other suppliers in the same market will only consolidate the intention of the clients to terminate their relationship, at the moment when they feel dissatisfaction and discontent with the quality of the services. From this perspective, we try to formulate the following hypothesis:

- **H 4: The higher the attractiveness of the alternatives, the weaker the effect of a perceived lack of service quality on the intention to change the usual provider**

3. Method: Binary logistic regression

Several works have dealt with binary logistic regression models in the prediction of policyholders' churn in different insurance industries, the most recent of which are mentioned here. The essay by (Mauricio Henao M., and al., 2020): "Customer churn prediction in insurance industries: A multiproduct approach", implements logistic models to predict policyholder churn in different insurance lines in a general way and without any segmentation. Also, the paper by (M. À. de la Llave, and al., 2020) entitled: "The impact of geographical factors on churn prediction: an application to an insurance company in Madrid's urban area", highlights the prediction of churn influenced by geographical determinants in the urban area of Madrid using binary logistic regression. Similarly, (Manohar Giri's 2018) presented in India, a

thesis titled: "A behavior study of life insurance purchase decision" uses the logistic model to predict the policyholder-initiated surrender behavior of life insurance contracts. Also, the paper by (Zhengmin Duan, and al., 2018), entitled: "A logistic regression based auto-insurance rate making model designed for the insurance rate reform" in China, tries to introduce a logistic regression based auto-insurance rate making model and design an insurance rate reform.

Through these different works, we note that the prediction of the act of cancellation of the insured confers to the use of generalized linear models, and more specifically the binary logistic regression. This choice can be explained by the duality of the policyholders' decision at maturity, either to renew or to terminate their insurance contracts as mentioned above. Binary logistic regression is one of the simplest and fastest machine learning algorithms to implement, offering high simulation efficiency. Also, training a model with this algorithm does not require much computing power. However, it produces well-calibrated probabilities and classification results. This is an advantage over models that only produce the final classification results..

3.1. Binary logistic regression, an extension of generalized linear models

The essays of (Hosmer D. W., & Lemeshow S. 2000) as well as the work of (King G., & Zeng L. 2001), underline that logistic regression is understood as a relevant statistical choice, for situations in which the occurrence of a binary outcome must be predicted. In addition, (Burns R. B., and al., 2008), and (Muijs D., 2010) have offered clarifications of the steps necessary to perform such an analysis using a variety of statistical packages, such as SPSS, R, etc. While the explanation of the phases of performing such analysis in different particular contexts has also been mentioned on many websites, as highlighted in the works of (Greenhouse J. B., and al., 1995) as well as the writings of (Wuensch D. 2009).

3.2. Logit transformation

We consider a population P subdivided into two groups of individuals G_1, and G_2 identifiable by an assortment of quantitative or qualitative explanatory variables $X_1, X_2, \dots X_p$ and let Y be a dichotomous qualitative variable to be predicted (explained variable), worth (1) if the individual belongs to the group G_1, and (0) if he/she comes from the group G_2. In this context, we wish to explain the binary variable Y from the variables $X_1, X_2, \dots X_p$.

We have a sample of n independent observations of y_i, with $i = 1, 2, ..., n$. y_i denotes a dependent random variable presented as a column vector such that, $y_i = (y_1, y_2, ... y_n)$ expressing the value of a qualitative variable known as a dichotomous outcome response, which means that the outcome variable y_i can take on two values 0 or 1, evoking respectively the absence or the presence of the studied characteristic. We also consider a set of p explanatory variables denoted by the design matrix (X) = $(X_1, X_2, ... X_p)$ grouping the column vectors of the independent variables, of size $(n \times p)$ and rank (p), where (x_i) is the row vector of these explanatory variables associated with the observation (i) such that, i = 1, 2, …, n, and the column vector (β) of dimension p of the unknown parameters of the model, i.e. the unknown regression coefficients associated with the column vectors of the matrix (X). We consider in this paper that y_i (response variable) is a realization of a random variable y_i that can take the values 1 in the case that corresponds to the probability of tourism companies succeeding in overcoming the health crisis or 0 in the case of the probability of failing to overcome this crisis with probabilities of (π) and (1-π) respectively.

The distribution of the response variable y_i is called Bernoulli distribution with parameter (π). And we can write y_i ~ B(1, π). Let the conditional probability that the outcome is absent be expressed by P(y_i = 0|X) = 1 − π and present, denoted P(y_i = 1|X) = π, where X is the matrix of explanatory variables with p column vectors. The modeling of response variables that have only two possible outcomes, which are the "presence" and "absence" of the event under study, is usually done by logistic regression (Agresti, 1996), which belongs to the large class of generalized linear models introduced by John Nelder and Robert Wedderburn (1972). The Logit of the logistic regression model is given by the equation:

$$\text{Logit}(\pi) = \ln\left(\frac{\pi}{1-\pi}\right) = \sum_{k=0}^{p} \beta_k x_{ik}, \text{ with } i = 1, \ldots, n \quad (1)$$

By the Logit transformation, we obtain from equation (1) the equation (2):

$$\left(\frac{\pi}{1-\pi}\right) = \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right) \quad (2)$$

We evaluate equation (2) to obtain π et 1 − π as:

$$\pi = \exp\left(\sum_{k=}^{p} \beta_k x_{ik},\right) - \pi \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right) \quad (3)$$

$$\pi + \pi \exp\left(\sum_{k=0}^{p} \beta_k x_{ik},\right) = \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right) \quad (4)$$

$$\pi \left(1 + \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)\right) = \exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right) \quad (5)$$

$$\pi = \left(\frac{\exp(\sum_{k=0}^{p} \beta_k x_{ik})}{1+\exp(\sum_{k=0}^{p} \beta_k x_{ik})}\right) (6)$$

$$\pi = \left(\frac{1}{1+\exp(-\sum_{k=0}^{p} \beta_k x_{ik})}\right) (7)$$

In the same way, we obtain $(1 - \pi)$:

$$1 - \pi = 1 - \left(\frac{1}{1+\exp(-\sum_{k=0}^{p} \beta_k x_{ik})}\right)$$

$$1 - \pi = \left(\frac{1}{1+\exp(\sum_{k=0}^{p} \beta_k x_{ik})}\right)$$

$$1 - \pi = \frac{\exp(-\sum_{k=0}^{p} \beta_k x_{ik})}{1+\exp(-\sum_{k=0}^{p} \beta_k x_{ik})} \quad (8)$$

3.3. Estimation of the β parameters of the nonlinear equations of the Bernoulli distribution using the maximum likelihood estimator (MLE).

If y_i takes strictly two values 0 or 1, the expression for π given in equation (7) provides the conditional probability that y_i is equal to 1 given X, and will be reported as P(y_i = 0|X). And the quantity 1-π gives the conditional probability that y_i is equal to 0 given X, and this will be reported as P(y_i = 0|X). Thus, for y_i =1, the contribution to the likelihood function is π, but when y_i =0, the contribution to this function is 1 − π. This contribution to the likelihood function will be expressed as follows:

$$\pi^{y_i} (1 - \pi)^{1-y_i}$$

At this stage, we will estimate the P+1 unknown parameters β, using the maximum likelihood estimator (MLE) as follows:

$$L(y_1, y_2, \ldots y_n, \pi) = \prod_{i=1}^{n} \pi^{y_i} (1 - \pi)^{1-y_i}$$

Maximum likelihood is one of the most widely used estimation procedures for determining the values of the unknown β parameters that maximize the probability of obtaining an observed data set. In other words, the maximum likelihood function explains the probability of the observed data based on unknown regression parameters β. This method was developed by the British statistician Ronald Aylmer Fisher between (1912 - 1922) as it was assigned in John Aldrich's book "*R. A. Fisher and the making of maximum likelihood 1912-1922* " published in (1997). This method aims to find estimates of the p explanatory variables to maximize the probability of observation of the response variable *Y*.

$$L\ (y_1, y_2, \dots y_n,\ \pi) = \prod_{i=1}^{n} \pi^{y_i}\ (1-\pi)^{1-y_i}$$
$$= \prod_{i=1}^{n} \left(\frac{\pi}{1-\pi}\right)^{y_i}\ (1-\pi)$$

Substituting equation (2) for the first term and equation (8) for the second term, we obtain:

$$L\ (y_1, y_2, \dots y_n,\ \beta_1, \beta_2, \dots \beta_p,\ ) = \prod_{i=1}^{n} \left(\exp\left(\sum_{k=0}^{p} \beta_k\, x_{ik},\right)\right)^{y_i} \left(1 - \frac{\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)}{1+\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)}\right)$$

So,

$$L\ (y_1, y_2, \dots y_n,\ \beta_1, \beta_2, \dots \beta_p) = \prod_{i=1}^{n} \left(\exp\left(y_i\ \sum_{k=0}^{p} \beta_k\, x_{ik},\right)\right)\ \left(1 + \exp\left(\sum_{k=0}^{p} \beta_k\, x_{ik},\right)\right)^{-1}$$

For simplicity, we incorporate the neperian logarithm into the above equation. Since the logarithm is a monotonic function, any maximum in the likelihood function will also be a maximum in the log-likelihood function and vice versa. Thus, considering the natural logarithm of this equation, we obtain the log-likelihood function ℓ expressed as follows:

$$\ln\left(L\ (y_1, y_2, \dots y_n,\ \beta_1, \beta_2, \dots \beta_p)\right) =$$
$$\ln\left(\prod_{i=1}^{n} \left(\exp\left(y_i\ \sum_{k=0}^{p} \beta_k\, x_{ik}\right)\right)\ \left(+\exp\left(\sum_{k=0}^{p} \beta_k\, x_{ik}\right)\right)^{-1}\right)$$
$$\ell\ (y_1, y_2, \dots y_n,\ \beta_1, \beta_2, \dots \beta_p) = \sum_{i=1}^{n} y_i\ \left(\sum_{k=0}^{p} \beta_k\, x_{ik}\right) - \ln\left(1 + \exp\left(\sum_{k=0}^{p} \beta_k\, x_{ik}\right)\right)$$

Deriving the last natural logarithm equation of the likelihood function above, we should write:

$$\frac{\partial \ell(\beta)}{\partial \beta_k} = \sum_{i=1}^{n} y_i\ x_{ik} - \frac{1}{1+\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)}\ \times \frac{\partial}{\partial \beta_k}\left(1 + \exp\left(\sum_{k=0}^{p} \beta_k\, x_{ik}\right)\right) \quad (9)$$

$$\frac{\partial \ell(\beta)}{\partial \beta_k} = \sum_{i=1}^{n} y_i\ x_{ik} - \frac{1}{1+\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)}\ \times \exp\left(\sum_{k=0}^{p} \beta_k\, x_{ik}\right) \times \frac{\partial}{\partial \beta_k} \sum_{k=0}^{p} \beta_k\, x_{ik} \quad (10)$$

$$\frac{\partial \ell(\beta)}{\partial \beta_k} = \sum_{i=1}^{n} y_i\ x_{ik} - \frac{x_{ik}}{1+\exp\left(\sum_{k=0}^{p} \beta_k x_{ik}\right)}\ \times \exp\left(\sum_{k=0}^{p} \beta_k\, x_{ik}\right) \quad (11)$$

Knowing that:

$$\frac{\partial}{\partial \beta_k} \sum_{k=0}^{p} \beta_k\, x_{ik} = x_{ik}$$

$$\frac{\partial \ell(\beta)}{\partial \beta_k} = \ell'_{\beta_k} = \sum_{i=1}^{n} y_i\ x_{ik} - \ \pi . x_{ik} \quad (12)$$

Therefore, the estimation of the parameters $\hat{\beta} = (\widehat{\beta_0}, \widehat{\beta_1}, \cdots, \widehat{\beta_p})$that maximize the log-likelihood function l can be determined by canceling each of the *P +1* equations of ℓ' (gradient of ℓ) as

mentioned in equation (12), and verify that its Hessian matrix (second derivative) is negative definite, i.e. that each element of the diagonal of this matrix is less than zero (Gene H. Golub and Charles F. Van Loan 1996). The Hessian matrix consists of the second derivative of equation (12). The general form of the second partial derivative matrix (Hessian matrix) can be written as follows:

$$\frac{\partial^2 \ell(\beta)}{\partial \beta_k \, \partial \beta_{k'}} = \frac{\partial}{\partial \beta_{k'}} \sum_{i=1}^{n} y_i \, x_{ik} - \pi . x_{ik} \quad (13)$$

$$\frac{\partial^2 \ell(\beta)}{\partial \beta_k \, \partial \beta_{k'}} = \frac{\partial}{\partial \beta_{k'}} (- \pi . x_{ik}) \quad (14)$$

$$\frac{\partial^2 \ell(\beta)}{\partial \beta_k \, \partial \beta_{k'}} = - x_{ik} \frac{\partial}{\partial \beta_{k'}} \left(\frac{\exp(\sum_{k=0}^{p} \beta_k x_{ik})}{1+\exp(\sum_{k=0}^{p} \beta_k x_{ik})} \right)$$

$$\ell''_{\beta_k \beta'_k} = - x_{ik} \, \pi(1-\pi) \, x_{ik} \quad (15)$$

To solve the $(P+1)$ nonlinear β equations (12), we use the Newton-Raphson iterative optimization method, referring to the Hessian matrix. Using this method, the estimation of the β parameters starts with the first step of choosing a starting point β^{0} or β^{old}. The second step consists in mentioning the way the method works by posing: $\beta^{k+1} = \beta^{k} + A_k \times \nabla L(\beta^{k})$, and finally stop when the condition $\beta^{k+1} \approx \beta^{k}$ or $\nabla L\beta^{k+1}) \approx \nabla L(\beta^{k})$ is realized. The result of this algorithm in matrix notation is:

$$\beta^{new} = \beta^{old} + [-\ell''(\beta^{old})]^{-1} \times \ell'(\beta^{old})$$

By putting $\hat{\beta} = (\widehat{\beta_0}, \widehat{\beta_1}, \cdots, \widehat{\beta_p})^t$ we have:

$$V(\hat{\beta}) = (- \frac{\partial^2}{\partial \beta^2} \ln L(\beta, Y))^{-1} \|_{\beta=\hat{\beta}} = (X^t W X)^{-1}$$

To simplify this equation above, we substitute the value of $\ell'(\beta)$, and $\ell''(\beta)$ with another matrix form in the following way:

$$\beta^{new} = \beta^{old} + (X^t W X)^{-1} \times X^t (Y - \mu) \quad (16)$$

$$\beta^{new} = (X^t W X)^{-1} \times X^t W (X\beta^{old} + W^{-1}(Y - \mu)) \; \beta^{new} = (X^t W X)^{-1} X^t W Z \quad (17)$$

Where $Z = (X\beta^{old} + W^{-1}(Y - \mu))$ is a vector, and W is the vector of weights of the values of the diagonal of the inputs $\hat{\pi}_i(1 - \hat{\pi}_i)$. We can also write:

$$\beta^{new} = \beta^{old} + (X^t W X)^{-1} \times X^t (Y - \mu) \quad (18)$$

With:

$$X = \begin{pmatrix} 1 & x_{1,1} & \cdots & x_{1,p} \\ 1 & x_{2,1} & \cdots & x_{2,p} \\ \vdots & \vdots & \vdots & \vdots \\ 1 & x_{n,1} & \cdots & x_{n,p} \end{pmatrix}$$

$$\hat{V} = \begin{pmatrix} \widehat{\pi_1}(1 - \widehat{\pi_1}) & 0 & \cdots & 0 \\ 0 & \widehat{\pi_2}(1 - \widehat{\pi_2}) & \cdots & 0 \\ \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \cdots & \widehat{\pi_n}(1 - \widehat{\pi_n}) \end{pmatrix}$$

And:

$$W = \text{Diag}\ \widehat{\pi_1}(1 - \widehat{\pi_1}), \cdots, \widehat{\pi_n}(1 - \widehat{\pi_n})$$

3.4. Odds and Odds-ratios

The odds ratio (OR) is a statistical procedure used to evaluate the association between two qualitative random variables. This procedure is often used in logistic regression to measure a relative effect. Knowing that we are in a case of a dichotomous response variable y_i (binary logistic regression), the probability of having Y=1 knowing that X= x is noted π_i. We determine the chance (odds) of having (Y =1|X = x) rather than having (Y = 0|X = x) by the ratio {π}/{1-π}. The odds ratio can be expressed as follows:

$$OR = \frac{\pi(x+1)/[1-\pi(x+1)]}{\pi(x)/[1-\pi(x)]}$$

4. Results and discussion

The present study focuses on the use of an online questionnaire for data collection. The construction of the questionnaire used in this research is inspired by the literature of several works and books authors. This survey mainly covers two question areas. The first one is about the insured's information, vehicle, and car insurance. The second component includes questions about the determinants of termination of the relationship between the insured and their auto insurance provider. However, customer information is private and would not be disclosed.

We carefully use sampling to control for the representativeness of the sample (simple random sample). The sample is composed of 550 policyholders, taking into account the size of the

survey population. After deducting the questionnaire from the original 550, we obtain a total of 500 valid questionnaires. The first introductory part of the questionnaire is dedicated to the personal information of the respondent (insured) and his relationship with his insurer. This section of the survey is dedicated to the gender of the insured, age range, city of residence, socio-professional category, insurance companies contracted by the insured, car insurance contract types, and frequency of car insurance. The second part is reserved for responses to multiple-choice questions related to the explanatory determinants of the dependent variable using a Likert scale. Finally, the survey is completed with a dichotomous response question concretizing the scenario of actual termination or renewal of car insurance contracts at the end of the contract.

We consider a sample n split into two groups of insureds G_1 and G_2 identifiable by a set of independent variables X_1, X_2, X_3, X_4. More precisely, X_1 represents the perceived lack of service quality, X_2 the involvement of policyholders, X_3 the cost of switching from the usual insurer, X_4 the insurance market alternatives (competition). Let Y be the dichotomous qualitative variable to be predicted (response variable) expressing: The decision to cancel the car insurance contract at the end of the term. Y has the value (1) if the insured belongs to the group G_1 and (0) if he comes from the group G_2. Noting also that G_1 is dedicated to policyholders choosing to terminate their car insurance contracts at the end of the contract, and G_2. is dedicated to those who decide to renew their contracts at the end of the contract. Hence, we can write:

Table Nº 1: Coding of the response variable Y

Y = 1	Cancellation of the automobile insurance contract at maturity
Y = 0	Renewal of auto insurance policy at maturity.

Source: Authors

However, the explanatory variables introduced in the "Logit" model to predict the "decision to terminate" (dependent variable) are in the order of four dimensions.

Table Nº 2: Explanatory variables and their items

X_1	X_{11} X_{12} X_{13}	**Failure of the quality of services offered (Quality).** - *Failure of services before the insurance contract was taken out* (QUAL1) - *The failure of services during the contract period* (QUAL2) - *Failure of services after the claim* (QUAL3)

X_2	X_{21} X_{22}	**The involvement of policyholders (Involvement).** - *The degree of knowledge of car insurance product* (INVO 1) - *The emotional relationship with car insurance company* (INVO 2)
X_3	X_{31} X_{32} X_{33}	**The cost of changing the provider (Cost).** - *Breakthrough costs* (COST 1) - *Learning costs* (COST 2) - *Fixed costs* (COST 3)
X_4	X_{41}	**The insurance market alternatives (Alternative).** *The insurance market alternatives* (ALT 1)

Source: Authors

In this study, we have tried to identify the variables that predict the act of termination and to measure the impact of each of them on the decision of policyholders to renew or terminate their contracts with their usual insurer. However, the predictor variables introduced into the model to explain the act of switching are qualitative.

Table N° 3: Reliability test

Cronbach's Alpha	Cronbach's Alpha based on standardized elements	Number of elements
0.817	0,818	9

Source: Authors-SPSS

According to the reliability test, we notice that the value of the coefficient $\hat{\alpha} = 0.817$ exceeds the conventional minimum threshold of $\alpha = 0.70$ (Nunnally J. C. 1978), (Darren and Mallery 2008) revealing that we obtain, for this assortment composed of nine elements, a satisfactory internal consistency.

Table N° 4: Interelements correlation matrix

	X_{11}	X_{12}	X_{13}	X_{21}	X_{22}	X_{31}	X_{32}	X_{33}	X_{41}
X_{11}	1	0,287	0,171	0,402	0,347	0,501	0,391	0,589	0,640
X_{12}	0,287	1	0,391	0,405	0,378	0,333	0,283	0,120	0,589
X_{13}	0,171	0,391	1	0,36	0,414	0,553	0,249	0,490	0,209
X_{21}	0,402	0,405	0,36	1	0,55	0,574	0,452	0,499	0,408
X_{22}	0,347	0,378	0,414	0,553	1	0,501	0,439	0,248	0,509
X_{31}	0,501	0,333	0,212	0,574	0,501	1	0,616	0,503	0,590
X_{32}	0,391	0,283	0,249	0,452	0,439	0,616	1	0,509	0,449
X_{33}	0,589	0,120	0,490	0,499	0,248	0,503	0,509	1	0,402
X_{41}	0,640	0,589	0,209	0,408	0,509	0,590	0,449	0,402	1

Source: Authors-SPSS

The matrix of inter-element correlations is a matrix of statistical correlation coefficients calculated based on several variables taken two by two. It allows for quick detect the existing links between the introduced variables by foreseeing several studies and statistical explanations beforehand. However, the correlation matrix is symmetrical, and its diagonal is made up of 1's since the correlation of a variable with itself is perfect. The correlation matrix based on our study's answers shows that all the variables used are sufficiently correlated, with a correlation coefficient varying between r = 0.171 and r = 0.617 noting that: $0.171 \leq r \leq 0.640$, confirming moreover the result of Cronbach's Alpha reliability coefficient.

Table Nº 5 : Summary of models

Pas	-2 Log of Likelihood	R-2 of Nagelkerke	R square of the sum of squares	R square (Adjust) of the sum of squares
1	527,321	0,711	0,722	0,701

Source: Authors-SPSS

The model summary table provides the values of (-2LL), Cox and Snell R-two, and Nagelkerke R-two for the full model. The value of (-2LL) for this model is 527,321. This value was compared to that of the baseline model using the chi-square test to reveal a highly significant decrease between the two ($p = 0.000 < 0.05$). This deterioration justifies that the new model is significantly better fitted than the null model. Furthermore, the Nagelkerke R^2, which is an adjusted version of the Cox-Snell R-two and therefore closer to reality, is 0.711. This means that the model used explains 71.1% of the dispersion of the explained variable. In addition, a high value of the adjusted R^2 also called the adjusted coefficient of determination, refers to a better adjustment of the model to the data used. In our case, the binary logistic regression model explains the adjusted R^2 coefficient of determination = 0.722, i.e. 72.2% of the dispersion.

Table 6 : Chi-square test

	X_{11}	X_{12}	X_{13}	X_{21}	X_{22}	X_{31}	X_{32}	X_{33}	X_{41}
Value	20,34	23,94	24,05	19,46	18,30	16,11	16,81	15,91	22,24
Asymptotic significance	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Source: Authors-SPSS

We find from the chi-square test results that all the constituent items of the explanatory variables are highly significantly related to the response variable, pointing to an asymptotic (two-sided) significance value of $p = 0.000 < 0.05$. These results suggest that the null hypothesis

H_0 should be rejected.

Table 7: Table of variables in the equation

Items	$\hat{\beta}$	Wald	ddl	Sig	exp($\hat{\beta}$)	onfidence interval confidence interval 95% forexp($\hat{\beta}$)	
						Inf.	Sup.
X_{11}	0,511	*22,065*	*1*	*0,000*	*1,668*	*1,347*	*1,861*
X_{12}	0,396	*11,850*	*1*	*0,003*	*1,486*	*1,186*	*1,862*
X_{13}	0,537	*21,714*	*1*	*0,000*	*1,365*	*1,365*	*2,144*
X_{21}	*0,407*	*12,929*	*1*	*0,000*	*1,502*	*1,203*	*1,875*
X_{22}	*0,620*	*21,538*	*1*	*0,000*	*1,859*	*1,431*	*2,415*
X_{31}	*-0,365*	*6,277*	*1*	*0,012*	*0,694*	*0,512*	*0,924*
X_{32}	*-0,342*	*4,087*	*1*	*0,043*	*0,711*	*0,510*	*0,990*
X_{33}	*-0,472*	*11,360*	*1*	*0,001*	*0,624*	*0,474*	*0,821*
X_{41}	*0,871*	*7,350*	*1*	*0,007*	*2,388*	*1,237*	*4,482*
Constant	*-8,295*	*74,916*	*1*	*0,000*	*0,000*	-	-

Source: Authors-SPSS

The table above provides us with the regression coefficients $\hat{\beta}$, the Wald statistic for testing statistical significance, the odds ratio Exp($\hat{\beta}$), and finally the confidence intervals of the odds ratios (OR) for each item constituting the explanatory variables used in the study. Before analyzing the results obtained, it can be seen that the range of items used has, in general, a highly significant effect on the binary dependent variable 'cancellation/renewal of car insurance contracts on expiry'. This significance is illustrated by a p (Sig.) < 0.05 for all the items introduced into the survey.

Furthermore, it is easy to interpret the statistical significance of the association between the dichotomous response variable Y and the items of the model's explanatory variables. This association is estimated by comparing the significance level p of each item with the conventional significance level p = 0.05. However, being hypothesis tests, the statistical tests assume that a p < 0.05, leads to reject the null hypothesis H_0 and retain the alternative hypothesis H_1 exposing the existence of a significant relationship between the terms of the explanatory variables and the dependent variable Y. On the other hand, it does not make sense to interpret the regression coefficients $\hat{\beta}$, but it allows us to understand the direction of variation between the explanatory items of the model and the variable to be predicted Y. In other words, a positive sign of the regression coefficient $\hat{\beta}$ means a variation in the same direction between

the model terms. In other words, a positive sign of the regression coefficient $\hat{\beta}$ means a variation in the same direction between the model terms and the binary response variable. On the other hand, a negative sign of $\hat{\beta}$ confers an inverse relationship between them. Nevertheless, the exponential of $\hat{\beta}$ "(exp ($\hat{\beta}$))" refers to a term that is statistically easy to interpret. However, the "exp ($\hat{\beta}$)", also known as the odds ratio (OR), is a statistical estimator measuring the effect of the items introduced in the study on the dependent variable. The exp ($\hat{\beta}$) (Odds Ratio) column tells us the different intensities of associations between the item set and the variable being explained.

For items relating to the variable 'perception of the quality of insurance services', a shortcoming in the quality of services prior to taking out insurance contracts (responsiveness, ease of communication, flexibility, etc.) (QUAL 1), or weakness in services during the contract period (information, additional documents, etc.) (QUAL 2), or even a shortcoming in services in the event of a claim (responsiveness, quality of service, time taken to process claims, etc.) (QUAL 3) will likely encourage the insured to take out insurance. (QUAL 2), or even a deficiency in services in the event of a claim (responsiveness, quality of service, time taken to process claims, etc.) (QUAL 3), are likely to prompt the policyholder to dissolve his relationship with his usual provider and terminate his motor insurance contract on the expiry date. We note that poor quality of services offered before subscribing to (QUAL 1) contracts generates a greater chance of leaving the insurance company than of renewing with it, hence the (QUAL 1) OR = 1.668, and its IC5% = [1.347, 1.861]. Also, poor services presented during the contract period can induce breaking up with the insurer in a portion of more than one chance than staying with it, noting that the OR (QUAL 2) = 1.486, with a CI5% = [1.186, 1.861]. Similarly, poor service in the event of a claim can only lead to a discontinuity with the insurer by more than one chance of staying with it, reporting that the OR (QUAL 3) = 1.711, and its IC5% = [1.190, 2.144]. As mentioned in the results obtained, the starting hypothesis (H1) was approved. That is to say that a weakness in the services offered, whether it is the services offered before the contract is taken out, those offered during the commitment period, or even the services allocated in the event of a claim, are likely to commit the insured to a process of breaking off the relationship with his insurer.

In addition, a high level of policyholder involvement, incorporating knowledge of (INVO 1) motor insurance products and the emotional relationship with the (INVO 2) insurer, can lead to

the willingness of prospects to terminate their contracts with their usual providers. Being a moderating determinant of the act of termination, a deeply involved policyholder increases the positive effect of the termination drivers, i.e. a high level of involvement of the prospects stimulates the increase of the positive impact of the poor perception of the quality of the services offered on the intention of the policyholders to terminate their car insurance commitments at the end of the term, whereas a low level of involvement may lead to the retention of this association. As the results show, a significantly involved policyholder increases the effect of the termination drivers by more chance to activate the switching process and break the contract than to take out the contract again with the usual provider. However, we note, OR (INVO 1) = 1.502, CI 5% = [1.203, 1.875], OR (INVO 2) = 1.859, CI 5% = [1.431, 2.415].

Nevertheless, the 'switching costs' enveloping the three items, such as the break-up costs (COSTS 1) referring to the loss of former benefits, and the risk of making a wrong choice, the learning costs (COSTS 2) referring to the search costs as well as the costs of adapting to the new insurer, and the fixed costs (COSTS 3) referring to the time and effort allocated to consolidate the new relationship, can lead to a moderating effect of the act of termination. In other words, a low cost of changing the usual insurer can encourage the break with the company and dissolve the contract at the end of the term through the increase in the effect of the direct determinants of cancellation. On the other hand, a high cost encourages the insured to keep his association with the insurer by reducing the impact of the direct determinants on the termination decision. On the other hand, in our case, a negligible cost stimulates the positive effect of the incentive determinants of the termination act. These inferences can be seen in the low odds ratios obtained such as, OR (COSTS 1) = 0.694, CI 5% = [0.522, 0.924], OR (COSTS 2) = 0.711, CI 5% = [0.510, 0.990], and OR (COSTS 3) = 0.624, CI 5% = [0.474, 0.821].

Finally, the only item that shows the degree of knowledge of the alternatives offered by the Moroccan motor insurance market (ALT), underlines an important moderating impact on the decision to cancel. Furthermore, a perfect knowledge of the competition is twice as likely to increase the positive effect of the direct factors of cancellation and thus encourages the insured to withdraw from the contractual relationship with his insurance company instead of maintaining it. This finding is reflected in an OR (ALT) = 2.388, CI 5% = [1.273, 4.482]

Conclusion

We have come to the end of this research which aimed to answer the problem of predicting the act of cancellation of car insurance contracts initiated by policyholders and analyzing the impact of a failed insurance offer on their behavior at the end of the contract. Moreover, even the best insurance companies are not immune to the act of cancellation by their policyholders. Therefore, we aim to provide a better understanding of the act of cancellation in the motor insurance sector. In this vein, the objective of our research subject is to predict the act of termination of the relationship between the service provider and its prospect, to understand the termination process leading to the end of any contractual commitment initiated by the client, and to gather through a detailed literature review the different models and theories framing the incidence of poor quality of the services offered leading to a dissolution of the contractual relationship between the provider and its client. Our theoretical framework and variables drawn from the literature allowed us to build and operationalize our research model and hypotheses, hence our approach is to highlight the impact of a range of direct and indirect determinants of termination on the switching intentions of prospects from their usual provider in the car insurance sector in the city of Rabat.

To respond to our research problem, we have adopted a post-positivist epistemological position based mainly on hypothetico-deductive reasoning. Our research project is structured based on a theoretical framework laid down a priori from which one or more explanatory hypotheses of the termination phenomenon studied are drawn, while the empirical phase judges the validity or refutability of the initial hypotheses implemented. However, the method used in this study is said to be quantitative, giving the use of online questionnaires an exploratory dimension. After collecting data on the policyholders' responses, we mobilized an extension of the generalized linear models, more specifically binary logistic regression, to predict the act of terminating car insurance contracts initiated by policyholders at their expiry dates.

As a result, the failure of the quality of services before the insurance contract is taken out (QUAL 1), or of services during the contractual period (QUAL 2), or even of post-claims services (QUAL 3), has a positive impact on the decision to terminate a car insurance contract on expiry, as the customer is more likely to cancel than to renew the contract with the usual insurer. About the act of churn, the moderating determinants can play a dual role, either

stimulating the effect of the direct determinants or curbing them. Nevertheless, a high level of involvement, reflected in a high degree of knowledge of the motor insurance product (INVO 1), and a better affective relationship with the insurer (INVO 2), leads to an increase in the impact of the direct determinants on the decision to cancel. On the other hand, low involvement is likely to reduce the impact of these precipitating factors on the termination of contracts at their end. Also, the costs of change in their different aspects, such as break-up costs (COSTS 1), learning costs (COSTS 2), or even fixed costs (COSTS 3), are negatively correlated with the direct and stimulating factors of the act of termination. That is, high switching costs dampen these direct antecedents, while poor costs increase their impact on the final decision to terminate. Finally, a good knowledge of the alternatives (ALT) offered by the insurance market also broadens the influence of the direct churn factors on the final decision of the insured at the end of the contract.

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