

**Applying FCM to Predict the Behaviour of Loyal Customers in the Mobile
Telecommunications Industry.**

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Abstract

Using empirical data from the Kuwaiti mobile telecommunications sector, this study models a fuzzy cognitive map (FCM) to investigate the reciprocal effects of customer loyalty and its antecedents in an emerging market context. This study investigates the effect of perceived service quality, perceived service value and brand equity on customer loyalty and the simultaneous analysis of the reverse causality of these variables. Data pertaining to 350 subscribers were analysed. According to the results, the model reaches the equilibrium when brand equity and customer loyalty are increased and reach an optimal level. Based on these findings, the authors provide implications for managers in the mobile telecom industry.

Keywords: *Fuzzy Logic, Customer Loyalty, Brand Equity, Service Quality, Service Value*

1. Introduction

Customer retention is widely regarded as a key determinant of businesses' long-term success and viability. As such, companies concentrate on establishing and maintaining long-term relationships with customers (Roos et al., 2009) in their efforts to achieve sustainable competitiveness and profitability. The development and retention of a solid base of loyal customers can lead to financial stability (Lai et al., 2009), positive word of mouth, employees' performance enhancement (Lee and Cunningham, 2001) and resistance to competition (Lewis and Soureli, 2006). Hence, service providers strive to deliver improved service value and increased service quality, since part of customers' loyalty is determined by their evaluation of what is received in the relationship (Vogel et al., 2008). Furthermore, customers perceive the service quality and value as of higher standards (Leone et al., 2006) when businesses provide them with a deep, brand-associated experience which, in turn, has become increasingly important in terms of developing long-term and profitable relationships.

Whilst the benefits of having a loyal customer base are broadly recognized (Cheng et al., 2008) and are apparent for all service industries (Dick and Basu, 1994), the drivers of customer loyalty in certain service sectors remain undiscovered (Tamaddoni Jahromi et al., 2010). While there is an active stream of research on consumer goods and grocery products (Aaker and Joachimsthaler, 2000; de Chernatony, 2001; Aaker, 2002), in terms of the service sectors, the application of branding was primarily explored by tourism scholars (Cai, 2002; Morgan et al, 2003, Lee et al, 2006; Hosany et al, 2006).

In the service marketing literature, two different sets of factors have been identified as antecedents of customer loyalty: a) factors derived from the experience customers receive from the service providers (e.g. Nam et al, 2011). In the present study, we argue that the

relationship between brand equity and loyalty needs to be analysed as a two-way relationship and in conjunction with the influence of specific service experience variables. To the best of our knowledge, this report describes an approach that no previous study has followed.

A service sector with limited empirical evidence, mobile telecommunications, was selected as the research setting of this study. This sector is of high interest and explosive performance, especially in most emerging economies (Awoloye et al., 2012). Therefore, we chose Kuwait, since it represents a highly competitive and rapidly changing mobile telecoms market. Meanwhile, Kuwait is still the only country in the Gulf region that does not have an independent telecoms regulatory authority.

On this basis and aiming to fill this gap in the pertinent literature, the present study develops and empirically tests a holistic conceptual framework that integrates customer loyalty with specific service experience variables (perceived service quality and perceived service value) and brand equity. Therefore, contribution of this paper lies in its radical aim to empirically examine the reciprocal effects of selected loyalty antecedents on customer loyalty. More specifically, this paper proposes a novel addition to the brand equity and customer loyalty research by offering a fuzzy cognitive map (FCM) approach. This mechanism aims to support decision-making, marketing planning and analysis by supporting a holistic reasoning of the anticipated customer loyalty. In other words, using FCMs, the mechanism proposes the development of a causal representation of dynamic customer loyalty antecedents. This modelling approach is considered to be novel, since the impact of reorganizing service quality, service value and brand equity activities is quantified and presented as a hierarchical and dynamic system of interconnected loyalty indicators. The values are estimated when the proposed model reaches the equilibrium, and valuable managerial implications are thus drawn.

2. Background and Research Scope

Only a small number of services studies concentrate on branding in the telecom industry (Melewar et al. 2005; Alamro and Rowley, 2011; Hijab et al. 2011; Nguyen et al., 2011). De Chernatony and Segal-Horn (2001) suggest that this lack of attention and consequent lack of services' branding knowledge has led to a paucity of successful services' brands. Therefore, little is known regarding the reciprocal effect between service brand equity and customer loyalty in the aforementioned setting (Chen and Myagmarsurenb, 2011).

The mobile telecommunications sector is a highly competitive field in many emerging economies (Kitchen et al., 2015). In fact, only a small number of research studies in this sector have investigated the antecedents of customer loyalty. These studies have primarily focused on the investigation of the socio-economic effect of telecom growth (Awoloye et al., 2012) or the effects of competition (Hassan, 2011). Although it would be questionable to claim that service quality and value can lead to customer satisfaction, to date limited evidence exists pertaining to the factors that could affect service brand equity and the resulting customer loyalty in emerging economies (He and Li, 2011).

Customer loyalty refers to the continuous and repeated purchase of a product/service and the ongoing relationship between a business and a customer (Dick and Basu, 1994). In the literature, most of the studies investigate brand loyalty, while loyalty in the services area is relatively undetermined (Lee and Cunningham, 2001).

On the one hand, brand equity refers to the differential effect of brand knowledge on consumers' responses to the marketing activities of the brand (Keller, 2008). In particular, the overall brand equity is assessed on the basis of the outcome approach (Washburn et al., 2004), and it measures the differential effect of consumers' knowledge of mobile service brands/providers on their preferences for the focal brands. On the other hand, loyalty is mostly defined as a strong attachment to the brand by such behaviours as remaining attached to the

company, recommending its products, purchasing additional products or services from it, and so on (Severi and Ling, 2013). Brand loyalty influences their purchasing decisions for the same product (Tolba, 2011); hence, they become more loyal to the service. Consumers developed brand loyalty by creating a positive output of the brand equity, which positively engenders brand preference over other brands (Zhang et al., 2014). On the other hand, the role of managers in the service industry is to formulate strategies to raise the level of their customer loyalty that apparently lead service firm growth and foster business sustainability (Chen & Cheng, 2012). Thus, formulating strategies is an important goal in the consumer marketing community, since it is a key component of a company's long-term viability or sustainability.

It has been argued that brand equity is particularly important for service firms (Krishnan and Hartline, 2001), since brands can help reduce customers' perceived risks that are attributed to the intangible and variable nature of services (Bharadwaj et al., 1993). In addition to that, Keller (1998) states that one of the characteristics of brands possessing strong brand equity is stronger brand loyalty. This position appears consistent with that of Aaker (1991), who argued that brand loyalty could be considered both a dimension and an outcome of brand equity. Many studies on consumer-based brand equity have examined brand related variables (e.g. brand awareness) as determinants of brand loyalty (Yoo and Donthu, 2001), but only a small number (Taylor et al., 2004, Chen and Myagmarsurenb, 2011; Susanty and Kenny, 2015) have empirically tested and suggested the effect of brand equity on customer loyalty. Overall, we posit that

H_{1a}: Overall brand equity positively influences customer loyalty

H_{1b}: Customer loyalty positively influences overall brand equity

Perceived value (Lai et al., 2009) and service quality (Oyeniya and Abiodun, 2010) have been considered as loyalty predictors. Research into customer loyalty has focused primarily on product-related or brand loyalty, whereas loyalty to service organizations has remained underexposed (Jiang et al., 2016). Customer loyalty is attitudinally measured in terms of customers' intentions to continuously or increasingly conduct business with their present company, and their inclination to recommend the company to other persons (Zeithaml et al. 1996). From an attitudinal perspective, customer loyalty has been viewed by several researchers as a specific desire to continue a relationship with a service provider (Czepiel & Gilmore, 1987). From a behavioural view, customer loyalty is defined as repeated patronage. In other words, customer loyalty is the proportion of times a purchaser chooses the same product or service in a specific category compared to the total number of purchases made by the purchaser in that category (Neal, 1999). Still, the intrinsic difficulty in services' conceptualisation (Lewis and Soureli, 2006), and the lack of relevant research highlights the need for a better exploration of services' customer loyalty.

Perceived service quality is defined as the comparison of expectations with actual performance and has been widely researched and conceptualized (Parasuraman et al., 1988). Several studies in other sectors suggest that service quality can lead to customer loyalty (Bloemer et al., 1998). As noted by Zeithaml (1988), service quality is one of the major drivers of perceived value which, in turn, leads to customer loyalty. The perceived service quality represents some aspects of perceived utility and benefits, and therefore it is likely to enhance the perceived value.

The positive effect of perceived quality on perceived value has been well documented by studies in different contexts (Yang and Peterson, 2004). Generally, service quality is viewed as subjective in nature and as an attitude. According to Zeithaml et al. (2003), service quality

is the subjective evaluative judgement of consumers based on the service performance they encounter. Furthermore, Gronroos (2007) described service quality as the quality of what the consumer actually receives as a result of the interaction with the service firms; therefore, it is considered to be important in assessing the quality of service in determining customer's satisfaction and loyalty. In the services sector, prior research has found that perceived value is positively predicted by service quality (Cheng et al., 2008).

Perceived quality has also been advocated as a crucial source of brand equity (Bell et al., 2005), since strong service brands are usually built upon superior service quality (Berry, 2000). The strength of the brand could be traced from customers' perceptions and the understanding about what they have gained, observed, sensed and heard regarding a brand as a consequence of the customers' past involvement with a particular brand (Keller, 2008). From a managerial perspective, measuring perceived value is essential in assessing current services and for the development of further ones. That importance is observed because customer segments may have different motives to use services; thus, they perceive different values in them. Therefore,

H₂: Perceived service quality positively influences perceived service value

H_{3a}: Perceived service quality positively influences customer loyalty

H_{3b}: Customer loyalty positively influences perceived service quality

H₄: Perceived service quality positively influences overall brand equity

According to Zeithaml (1988), the customers' evaluations of the utility of a service are considered to be the provider's value offer. This value is later considered in terms of benefits and costs and the outcome is the perceived value of the service (Lovelock, 2011). Ravald and Grönroos (1996) indicated that companies can increase customers' perceived

benefits by providing superior value through their offers, which achieves higher customer satisfaction and loyalty. Service value is regarded as an antecedent of customer loyalty (Yang and Peterson, 2004). Thus, when value is perceived to be superior, it is expected to enhance loyalty and brand equity. Prior studies suggest that perceived value reduces the tendency to seek alternatives and significantly drives customer loyalty for online services (He and Mukherjee, 2007). Perceived value (Yang and Peterson, 2004) is also a decisive driver of brand equity. Therefore,

H_{5a}: Perceived service value positively influences customer loyalty

H_{5b}: Customer loyalty positively influences perceived service value

H₆: Perceived service value positively influences overall brand equity

The model proposed in Fig. 1 suggests that perceived service value and quality along with brand equity are significant predictors of customer loyalty. However, at the same time, customer loyalty could have an effect on the abovementioned variables. Similarly, perceived service value and quality both have direct effects on customer loyalty and vice versa, as well as indirect effects through brand equity. It holds that service providers can employ satisfaction derived from high service quality and competitive value offers in order to invest in a strong brand and thus increase the level of their customers' loyalty. To the best of our knowledge, no prior research has attempted to investigate the reciprocal effects of using fuzzy logic techniques on the abovementioned model.

INSERT FIGURE 1 HERE

3. Methodology

Traditional quantitative techniques of systems modelling have significant limitations (Qiu et al. 2016). In most cases, it is highly difficult to adequately describe the behaviour of a nonlinear system using mathematical models, especially when the structure of the system is unknown. Even if one knows the structure, numerical model representations usually become irrelevant and computationally inefficient as the complexity grows. After all, there are many uncertainties, unpredictable dynamics, mutual interactions, and other unknown phenomena that cannot be mathematically modelled at all (Xu & Li, 2016). Although replication research plays an important role in business research (Easley et al., 2000), research has shown that a number of original models were not always supported in replication studies (Hubbard and Vetter, 1996; Darley, 2000). In other words, safe conclusions cannot be extracted for an emerging economy from just a replication study.

In attempt to obtain more flexibility and a more effective capability of handling and processing uncertainties in complicated and ill-defined systems, Zadeh (1973) proposed a linguistic approach as the model of human thinking, which introduced fuzziness into systems theory. Therefore, the central characteristic of fuzzy systems is that they are based on the concept of the fuzzy partitioning of the information. The decision-making ability of the fuzzy model depends on the existence of a rule base and fuzzy reasoning mechanism.

In fuzzy logic, according to Smets and Magrez (1987), the truth value of a proposition is a predicate that can take values in the interval from $[0, 1]$. The fact that the truth domain is not restricted to the classical true and false values is due to the fuzzy nature of some of the elements of the proposition.

In any decision-making process, it is necessary to evaluate different alternatives and discard those that do not fit certain previously established criteria. If the criteria are

mathematically quantifiable, a mathematical model may be created for the evaluation process. The development of such models has the advantage of generalizing a solution to typical problems. The solution may subsequently be applied to other similar problems within or without the same area of focus. This problem may be solved using a more accurate procedure or model that may be used as a tool in the selection-making process and that guarantee a truthful final result. The fuzzy logic model that is presented in this paper allows the firm to understand the final weights of the variables under investigation and the prediction of the equilibrium. After the system reaches this stage, the weighting of the variables is going to be stable; thus, they will not change after that given time.

Fuzzy systems allow for the encoding of knowledge in a form that can be used to reflect the way humans think about a complex problem, such as service quality and service value (Akhter, 2005). A fuzzy expert system model for imprecise information by attempting to capture knowledge in a similar fashion to the way in which it is considered to be represented in the human mind, improves the cognitive modelling of a problem (Cox, 1994). As a result, fuzzy logic is leading to new, humanlike, intelligent systems that might be used to understand the thought processes behind the consumers' mind.

Since the main aim of the study is to examine the causal relationships described in its conceptual framework, a conclusive research design was selected. On this basis, we conducted a primarily quantitative survey on GSM subscribers in Kuwait with the use of a structured questionnaire. In choosing our sample, we employed random sampling to ensure the generalizability of the results to the overall population (Parasuraman et al, 2006).

The final questionnaire translation in Arabic was undertaken based on the team approach (Harkness, 2003), initiative and included the back-translation procedure. After being translated into the target language, the questionnaire was translated back into its source

language (i.e., English) and was followed by a comparison of both source language versions. A translator who was familiar with the terminology of the covered area and knowledgeable of both the English-speaking culture and the native equivalent to the target language was given the task and instructions to primarily approach the translation based on the emphasis of the original survey questionnaire.

The questionnaire was designed so that respondents would not be able to identify any links between the existing constructs. The questionnaire's structure and functionality were then pre-tested by 5 marketing experts and piloted with 20 subscribers. The participants were contacted, and they were instructed to submit their comments or queries once they have completed the questionnaire. The data were examined for non-response bias (Armstrong and Overton, 1977). As such, early respondents were compared to late respondents. No major modification was made to the questionnaire as a result of the pretesting process since no significant differences emerged between the two groups. (The Chi-square tests showed no significant differences between the two groups of respondents at the 5% significance level.) Hence, no issues of non-response bias were detected in the collected data.

The structured questionnaire was distributed in the city's industrial area, student concentrated areas, and low-income residential areas. Regarding the demographic profile of our sample, 57% of the respondents were males and 43% were females. The proportions are similar to the corresponding proportions in the general population of mobile telecom users, thus enhancing the representativeness of the sample. A total of 369 questionnaires were collected, of which 19 were excluded.

All of the variables were operationalized with the use of multi-item scales that were developed and tested by previous studies. Specifically, for the measurement of perceived service quality, we employed an 18-items scale that was adapted from Ganguli and Roy

(2010). A 4-item scale was adapted from Kim et al. (2007) to measure perceived value, a 4-item scale was adapted from Yoo and Donthu (2001) to measure overall brand equity and a 5-item scale was adapted from Aydin and Ozer (2005) to measure customer loyalty. All items that we included in the questionnaire were seven-point Likert-type, with anchors ranging from 'strongly disagree' (1) to 'strongly agree' (7).

Similar to previous research (Chang et al., 2010, MacKenzie and Podsakoff, 2012 and Podsakoff et al., 2003), ex-ante procedural remedies were used to address potential common method bias issues. Therefore, we provided the respondents with clear and consistent instructions and guaranteed their anonymity. Furthermore, it was made clear to the respondents that no right or wrong answers existed, and as such, they were not expected or led to give any specific answers on that basis. Furthermore, in order to identify the effects on the observed relationships, a statistical ex-post remedy was implemented (Lindell & Whitney, 2001). For that reason, a marker variable was employed as a means of comparing the structural parameters both with and without this measure. In line with the existing literature (Bagozzi, 2011), the second smallest positive correlation was used as a proxy for common method variance. After controlling for the marker variable, all coefficients that were significant in the bivariate correlation analysis remained statistically significant. Therefore, the results are not affected by any common method variance issues.

All scales were checked for their reliability and internal consistency, as reflected by the construct reliability assessed through Cronbach's α , and the summated multi-item scales were constructed based on the mean scores (Spector, 1992). Confirmatory factor analysis was employed and all measures were found to be unidimensional and valid in terms of both discriminant and convergent validity. Specifically, as depicted in Table 1, the percentage of all variables' explained variance (as reflected on their average variance expected (AVE)) is more

than 50% and higher than the highest squared correlation between the variables (Fornell and Larcker, 1981).

INSERT TABLE 1 HERE

4. Analysis and Results

To test the validity of the study's research hypotheses, we followed a fuzzy logic approach with the use of a Fuzzy Cognitive Map (FCM) that captured the strength of impact between the variables of the model. FCMs have been highly useful in modelling complex systems that involve diverse factors (Kang et al. 2004; Lee and Ahn, 2009), since they allow for a qualitative simulation of the system together with an investigation of what-if scenarios (Kosko, 1998). Fuzzy cognitive maps (FCMs) are fuzzy signed directed graphs that describe degrees of causality and webs of causal feedback. Since the fuzzy system output is a consensus of all of the inputs and all of the rules, fuzzy logic systems can be well behaved when weights are added to each rule in the rule base and are used to regulate the degree to which a rule affects the output values.

After identifying the directions and strengths of the mutual correlations between factors, the standardized causal coefficients were used to construct and investigate the corresponding FCM. In principle, FCMs are fuzzy directed graphs where nodes represent concepts and edges and take values between -1 and 1 . Negative and positive values indicate negative and positive causality respectively, while 0 indicates no causality. Hence, for every FCM with n nodes, we obtain a corresponding $n \times n$ matrix with values between $[-1,1]$, which is called its adjacency

matrix. The value of each concept at any discrete time step is obtained by computing the influence of the connected concepts with the appropriate weights after taking into account its previous value. By denoting $A_i(k)$ as the value of the concept C_i at discrete time step n and $E = (e_{ij})$ as the systems adjacency matrix, we can obtain the following rule describing the value of concept C_i at time step $k+1$. In equation (2), e_{ji} is the weight of the interconnection from concept C_j to concept C_i and $f(x)$ is an appropriate sigmoid threshold function, where m is a real positive constant.

$$A_i^{(k+1)} = f \left(A_i^{(k)} + \sum_{j=1}^n A_j^{(k)} \cdot e_{ji} \right) \quad (1)$$

$$f(x) = \frac{1}{1 + e^{-mx}} \quad (2)$$

On this basis, by utilizing the obtained standardized coefficients (as demonstrated in Figure 1), as a result of multiple regression analysis, we construct a Fuzzy Cognitive Map (FCM) that consists of 4 factors (Perceived Service Quality (PSQ), Perceived Service Value (PSV), Brand equity (BRE) and Customer Loyalty (CLO)) and 9 interconnections.

The adjacency matrix is $E =$
$$\begin{bmatrix} 0 & 0 & 0.39 & 0.28 \\ 0.28 & 0 & 0.19 & 0.24 \\ 0 & 0 & 0 & 0.56 \\ 0.31 & 0.21 & 0.34 & 0 \end{bmatrix}$$

	PSV	PSQ	BRE	CLO
$A^f =$	[0.804	0.644	0.906	0.935]

The constructed model evolves in discrete time steps according to the specified rule given by equations (1) and (2). A corresponding state vector $A^{(k)} = [PSQ, PSV, BRE, CLO]$ is obtained

at each time step until the systems reaches the equilibrium (i.e., $A^{(k+1)}= A^{(k)}$). The final state vector represents the equilibrium values of the four factors. This finding means that at a point in the future, the proposed model is going to be stable, and the four variables of the model are going to reach the following standardized weights.

5. Conclusions and Implications

The model presented in this study contributes to the limited research done in the areas of brand equity and customer loyalty in the services sector of emerging economies by providing sophisticated and statistically advanced knowledge through the use of FCMs. The proposed model has both theoretical and practical implications for marketing managers on the basis of suggesting the optimum values of the variables when the model is balanced or reaches the equilibrium. Given the apparent need for an effective redesign of empirical models, the proposed FCM uncovers the complex dynamics of customer loyalty. This approach is believed to be critical for anyone intending to effectively approach the customer base. The model chiefly affects the key stakeholders afforded with the task of decision making and assists them to effectively reason any implementation of tactics on the premise of changes in the variables of the process model. Alongside the grounded justification, the model also offers effort saving in decision-making. Moreover, the explanatory nature of the mechanism that links the customer loyalty antecedents can also be valuable from a wider theoretical angle. It adds to the understanding of the interrelations of the proposed variables and simulates the efficiency of achieving loyalty, which is a rather complex process with unclear relationships.

In detail, and in line with previous studies conducted in well-established economies (Cronin, 2000), both perceived service quality and perceived service value were shown to be good predictors of customer loyalty. According to optimum values set by the equilibrium,

PSQ (0.644) does not reach the same value as PSV (0.804). Perceived service value seems to have a greater importance than perceived service quality in the overall model. When customers perceive that the provider's service value and quality will reach the optimum level as set by the equilibrium values, they are averse from migrating to alternative providers. In view of the entrance of new competitive brands in the promising Kuwaiti mobile market, existing providers could increase the uncertainty of choosing other providers in order to offset competition (Liu et al., 2011). Providers that conscientiously attempt to offer advanced or differentiated high service quality to customers can manage to increase customer loyalty to the optimum level (Lai et al., 2009). This effect means that managers can expect to increase loyalty through the delivery of concrete promises and advanced value offers since the increase of customer retention and satisfaction can lead to the creation of a loyal customer base.

Furthermore, our results suggest that it would be beneficial for GSM providers to emphasize the brand in their promotional activities, since brand equity appears to be of primary importance in maintaining a loyal relationship, particularly in an environment of fierce competition. At the equilibrium, brand equity seems to reach the same high value as brand loyalty, which indicates that both variables could be optimized when operationalized in the context of our study. Thus, a firm should provide values and maintain offerings of high quality in order to increase perceived value and to create brands that are perceived as attractive and unique. Customers will then be less likely to switch (Vogel et al., 2008). This may require that managers employ contemporary marketing communication techniques (like experiential marketing techniques) in order to increase the involvement and emotional connections between the customer and the brand (Esch et al., 2006). At a later stage, stable customers' perceptions of the brand and the service quality can increase customer loyalty.

These inferences highlight the importance of having coordinated marketing programmes that integrate branding practices with loyalty creation processes based on service quality. As Kwon and Lennon (2009) suggested, in order to enjoy the benefits of customer loyalty (e.g., reduced customer acquisition costs and positive word-of-mouth), firms should not acquire customer loyalty through loyalty schemes but instead should achieve it through excellent service quality. In doing so, managers can place additional emphasis on reducing the factors that have been underscored as antecedents of poor service quality in the market. Constantly upgrading infrastructure will help to improve the quality of service. Nevertheless, GSM providers can expect to have better results in terms of customer retention if they can manage to tailor their service offerings in order to establish strong bonds between the brands and their customers.

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Figure 1. Conceptual framework with standardized regression weights

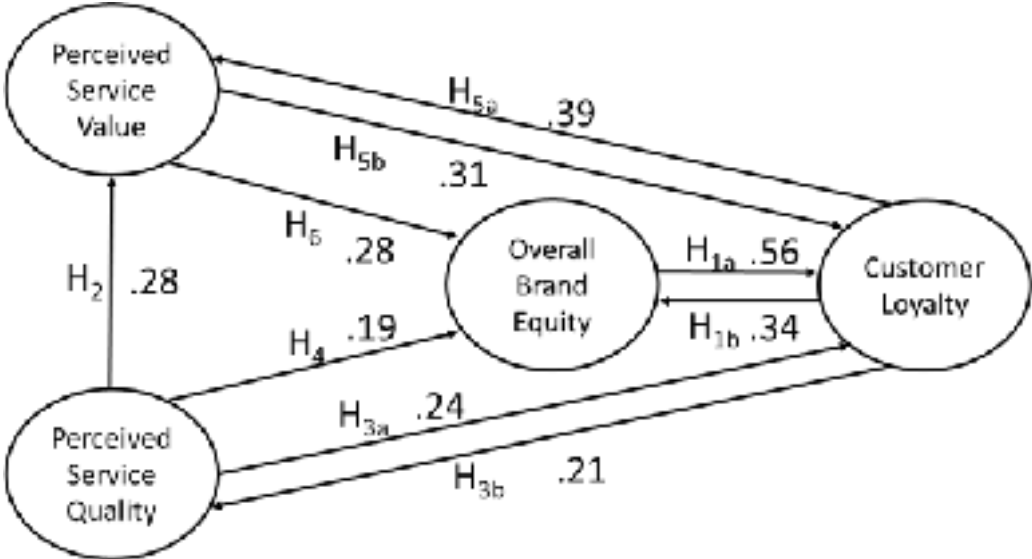


Table 1: Confirmatory factor analysis, reliability and validity

Constructs	CFI	RMSEA	AVE	Cronbach Alpha
Perceived service quality	0.92	0.09	0.62 > Max Correlation ²	0.79
Perceived service value	0.94	0.07	0.59 > Max Correlation ²	0.77
Overall brand equity	0.90	0.08	0.58 > Max Correlation ²	0.83
Customer loyalty	0.92	0.07	0.54 > Max Correlation ²	0.86