Defining a Scale for Procedural Switching Costs in buyer-supplier relationships using Item Response Theory

Abstract. Switching costs have been frequently used in theoretical models about customer retention strategies in interorganizational relationships. This study used Item Response Theory to develop an interpretable scale which can be used for the understanding of switching costs related to buyer-supplier relationships. The construct composed of 18 elements was applied to Brazilian companies of the food and beverage industry and their transport services providers. As a result, four groups of procedural switching costs were identified: minimum, medium, high and maximum, with most answers concentrated on the minimum level. This that food and beverage companies find it easy to change their transport service providers. For further research, TRI can be applied to the other the dimensions of switching costs proposed by the literature (i.e., financial and relational) in order to adequately assessing the multidimensionality of the construct analyzed. Furthermore, the proposed construct and extended versions can be applied to other inter-organizational contexts.

Keywords: Processual switching costs, Interorganizational relationships, Food and beverage industry, Transport services providers.

1 Introduction

The long-term interorganizational relationships (IORs) can take the form of buyer-supplier agreements, strategic alliances, joint ventures, licensing, co-branding, franchising, cross-industry partnerships, networks, trade associations, consortia (Parmigiani & Santos, 2011) and other possible arrangements. These relationships are considered hybrid models between market and vertical integration, and allow organizations to get economies of scale and scope in a more efficient way than through market transactions (Powell, 1990; Williamson, 1991).

In IORs, when a buyer switches a supplier, several costs can be incurred, from those related to the search for alternative suppliers to the benefits lost by abandoning the supplier (Jones et al., 2002). These costs are called switching costs and may originate from factors related to time, monetary and psychological costs incurred by buyers when they choose to switch suppliers (Dick & Basu, 1994; Kim et al., 2003). These costs constitute also barriers to switching suppliers, and can be presented in three different categories, which are: i) financial switching costs, which involve the loss of financial resources, such as the cost of loss of benefits and the cost of monetary losses; ii) relational switching costs; which involve the psychological or emotional discomfort due to the breakdown of ties, such as the cost of losing a personal relationship and a brand relationship; and iii) procedural change costs, which were the object of analysis in this investigation - related to loss of time and effort, such as economic risk, evaluation, learning and setup courses (Burnham et al., 2003).

Despite being associated with the switching process, switching costs are not necessarily incurred after switching suppliers and are not limited to economic costs. Furthermore, these costs are often not perceived and evaluated by organizations, but

come to be considered when buyers are confronted with a reason to switch suppliers (Burnham et al., 2003). Therefore, it appears that switching costs refer to a broad concept that may vary according to the characteristics of the product/service and the context investigated (Ghazali, 2011).

Switching costs can influence decisions to change suppliers of services, such as transport services, whose offer has been constantly modernized, following market trends, in order to meet the needs of clients and end customers (Martins et al., 2005). Transport represents the largest share of logistics costs in most organizations, being the most outsourced activity (Abrahão & Soares, 2006), and has a direct influence on buyer satisfaction. Indeed, according to Ballou (2006), if not well executed, it can negatively influence the general evaluation made by the customers, causing loss of loyalty due to poor delivery performance and a lower general quality of the service.

The transport of foodstuff products, in the food and beverage industry, needs to meet requirements imposed by the government and public agencies. In Brazil, the country's Health Surveillance Secretariat Ordinance No. 326, of July 30, 1997 (Brasil, 1997), regulates food conservation, handling and hygiene practices during transport, as a way to guarantee the quality and integrity of the products. These requirements lead to the demand for transport services using vehicles adapted to these services, generating specific investments which increase switching costs (Mentzer et al., 2001).

Switching costs have been included in customer loyalty models, however, there is a lack of consistency and clearness regarding their conceptualization and adequate measurement (Jones et al., 2002). In this sense, Blut et al. (2015) state that switching costs should be discussed from a multidimensional perspective, as carried out in the studies of Burnham et al. (2003) and Jones et al. (2002, 2007), who outlined specific taxonomies for evaluating switching costs considering their multidimensional nature. Switching costs are often evaluated unidimensionally (Geiger et al., 2012; Chen et al., 2022), however, these approaches can be too simplistic in terms of predicting managerial behaviors or contractual relationships (Whitten & Wakefield, 2006). Therefore, global measures of switching costs with undifferentiated dimensions may hinder the predictive capacity of the model.

The Item Response Theory (IRT) provides probabilistic models to measure variables that cannot be measured directly, such as switching costs, and can be used to establish a scale from a set of items related to what is intended to be measured, allowing the understanding of the latent trait (Van Der Linden & Hambleton, 1997;). In this way, it is possible that the parameters of the items are invariant about the respondents, and the latent traits of the respondents are also invariant about the items, except for the choice of origin and scale. Furthermore, a scale created based on the IRT has the advantage of placing both the items and the respondents on the same measurement scale, facilitating its interpretation (Andrade, Tavares & Valle, 2000). Therefore, TRI can contribute to the understanding of procedural switching costs resulting from interorganizational relationships namely, those established between food and beverage companies and transport service providers, with the creation of an interpretable scale, which was the objective of this study.

Understanding, evaluating and properly analyzing procedural switching costs allows organizations to outline customer retention and loyalty strategies (Dibb & Meadows, 2001; Blut et al., 2014), since higher costs represent a barrier to supplier

change. Both buyers and suppliers, should understand and manage properly switching costs in order to maximize the current relationships (Kim et al., 2010; Blut et al., 2014.

2 Materials and Methods

2.1 Population and Sample

The population of this research comprises the industrial food and beverage companies listed by Brazilian Associations of Food and Beverage Industries: Associação Brasileira da Indústria de Alimentos (ABIA), Associação Brasileira de Bebidas (ABRABE), Associação Brasileira das Indústrias de Softadas e de Bebidas nonalcoholicas (ABIR), and Associação Brasileira de Frigoríficos (ABRAFRIGO) which use outsourced transport services, totaling 531 companies. They were contacted directly at least one manager of 233 companies (44%). Additionally, the other 298 companies (56%) were requested by email to participate in the study. Thus, it was possible to establish contact with the 531 companies.

As these are practices related to contracting transport services, managers, coordinators, and supervisors in logistics, distribution, transport and supply chain were invited to participate in the survey. All of them are important, because they can influence cooperation strategies with carriers that provide services to the food and beverage industries.

They were sent 1,364 invitations, during the months of November and December 2020 and January 2021. The link to access the questionnaire was sent to the 481 employees (35.3%) who accepted the invitation.. Additional additional attempts were made to contact those who accepted the invitation, sending two participation reminders. At the end of the data collection process, 120 valid responses were obtained.

2.2 Latent Trace and Itens

The latent trait of interest is the procedural switching cost, composed of 18 items, based on Burnham, Frels and Mahajan (2003) is presented in Table 1.

Table 1. Construct for Procedural Switching Costs.

Element	Item	Description
Economic risk costs	CRE1	I am afraid that the service offered by other transport service providers may not work as well as expected.
	CRE2	If I try to change the main transport service provider, I might end up with poor service for some time.
	CRE3	Switching to a new transportation service provider is likely to involve hidden costs and charges.
	CRE4	Switching to a new transport service provider is likely to be a bad deal financially.
	CRE5	Switching to a new transportation service provider is likely to result in some unexpected hassle.
	CRE6	I don't know what I will have to deal with when switching to a new transportation service provider.

Valuation costs	CAV1	I don't have the time to get the information to fully evaluate other transportation service providers.
	CAV2	It will take a lot of time/effort to get the information I need to feel comfortable evaluating new transportation service providers.
	CAV3	Comparing the benefits of the main transport service provider with the benefits of alternative providers takes a lot of time/effort, even when I have information.
	CAV4	It is difficult to compare other transport service providers with the current one.
Learning costs	CAP1	It would take time to learn to use the features offered by a new transportation service provider the way I use the services of the current main provider.
	CAP2	We are not very engaged in understanding a new transportation service provider.
	CAP3	Even after switching to a new transportation service provider, it would take effort to "get into the groove" with that new provider.
	CAP4	It would be easy to get used to a new transport service provider (*).
Setup costs	CSU1	It takes time to go through the steps of switching to a new transportation service provider.
	CSU2	Changing transport service providers involves an unpleasant business process.
	CSU3	The process of getting started with a new transport service is quick/easy. (*)
	CSU4	There are many formalities involved in switching to a new transportation service provider.

(*) items with inverted scale.

Before sending the questionnaire to the researched population, a pre-test was carried out with the objective of identifying eventual flaws, inconsistencies, ambiguities and inadequate expressions to the interorganizational context investigated, as well as other intervening factors in the adequate understanding of the statements (Martins & Theóphilo, 2009). As a way of attesting to the reliability of the questionnaire, we sought to ensure the content validity of the data collection instrument, consulting three academic researchers in the field of controlling and management accounting.

2.3 Statistical Analysis of the Data

For each item, respondents indicated the level of agreement, on a scale from 1 (highest level of disagreement) to 7 (highest level of agreement). Items CAP4 and CSU3 had the scale inverted and, for the analysis, the categories were inverted (1 = highest agreement and 7 = highest disagreement). Due to the small number of responses, the responses to the items were dichotomized: categories 1 to 4 were converted into 0 and categories 5 to 7 were converted into 1.

The internal consistency of the data was verified using Cronbach's alpha (α) and McDonald's Omega (ωt), considering tetrachoric correlation. Bartlett's sphericity test and the Kaiser-Meyer-Olkin test (KMO) were performed to verify the fit of data to factor analysis. We assumed the same limits used by Silva et al. (2020): minimum of 0.7 for α and ωt indicates adequate internal consistency and KMO > 0.7 and $p < 5\%$ for

Bartlett's sphericity test represents a good fit of the data to factor analysis. The dimensionality of the test was assessed by Exploratory Factorial Analysis using tetrachoric correlation and parallel analysis.

The two parameter logistic model (2PLM - Equation 1) was used to estimate the discrimination (ai) and difficulty (bi) parameters of each item i and the parameter of the respondents (θj), which indicates the value of the switching costs of the relationship represented by each response j.

$$P_i(\theta_j) = \frac{1}{1+e^{-a_i(\theta_j - b_i)}} \quad (1)$$

where, Pi(θj) is the probability that the response j to item i is 1.

Package mirt of R-Project (Chalmers, 2012) was used to perform the parameter estimates. Items with ai < 0.65 were considered of low quality (Tirloni et al., 2016) and were eliminated.

For a better understanding of switching costs, the scale was divided into levels of 1 unit of θj, and the probability for response 1 was calculated from -1 unit of θj up to +3 units of θj. Probability values greater than 50% fixed item i at level Z.

The test information curve indicates the region of the scale with greater accuracy and it is the sum of the information for each item, calculated by equation 2. In logistic models, information is greater as larger is the value of 'a' and as 'b' is closer to θ (Alves and Bornia, 2011).

$$P_i(\theta) = \frac{[P_i'(\theta)]^2}{P_i(\theta) x Q_i(\theta)} \quad (2)$$

Where P_i^' (θ) is the first derivative of the response curve of the item (equation 1) and Q_i (θ)=1-P_i (θ) evaluated at a particular level of the latent trait.

The adjustment of the final model was evaluated and considered adequate when the Root Mean Square Error of Approximation (RMSEA) was <0.08 and the Comparative Fit Index (CFI) and the Tucker Lewis index (TLI) were >0.90. All statistical procedures were performed with R software (R Core Team, 2017).

3 Analysis of Results

The collected data presented satisfactory values of internal consistency with α = 0.84 and ωt = 0.91. The p-value of the sphericity test of Bartlett was $6*10^{-48}$ and KMO = 0.79 indicating a good fit of data to factor analysis.

3.1 Exploratory Factorial and Item Response Theory Analysis

The Parallel Analysis Sree Plot (see Fig. 1) shows that the unidimensional model is adequate.

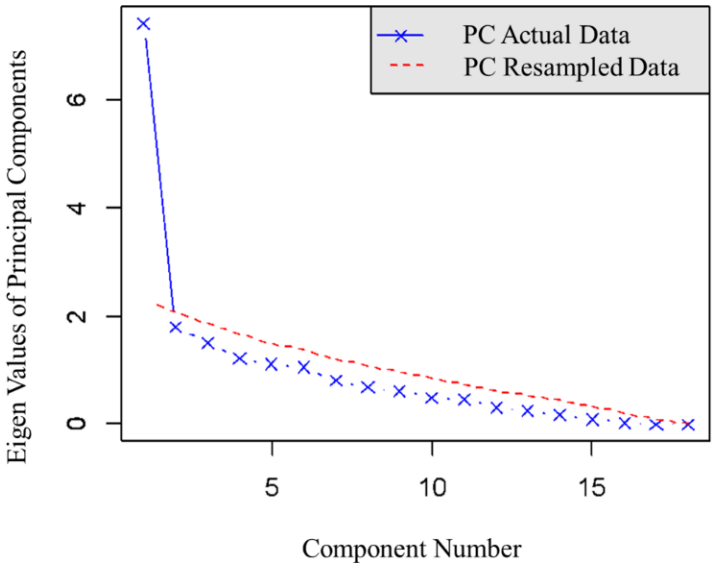

Fig. 1. Parallel Analysis Scree Plots.

Table 2 presents the factor loadings and parameters of the 2PLM.

Table 2. Factor Loadings and 2PLM Parameters Estimates.

Item	Load (F1)	h2	a	SE(a)	b	SE(b)
CRE1	0.69	0.4761	1.62	0.40	0.44	0.18
CRE2	0.70	0.4922	1.68	0.40	0.04	0.16
CRE3	0.55	0.3036	1.12	0.30	0.23	0.21
CRE4	0.83	0.6888	2.53	0.69	0.89	0.17
CRE5	0.82	0.6764	2.46	0.61	0.24	0.14
CRE6	0.59	0.3517	1.25	0.35	1.09	0.28
CAV1	0.59	0.3526	1.26	0.36	1.22	0.31
CAV2	0.73	0.5254	1.79	0.44	0.48	0.17
CAV3	0.66	0.4309	1.48	0.37	0.42	0.19
CAV4	0.85	0.7170	2.71	0.82	1.15	0.20
CAP1	0.61	0.3765	1.32	0.38	1.32	0.32
CAP2	0.55	0.3050	1.13	0.37	1.75	0.47
CAP3	0.76	0.5776	1.99	0.47	0.09	0.15
CAP4	0.37	0.1389	0.68	0.27	1.84	0.70
CSU1	0.61	0.3692	1.30	0.31	-0.20	0.19
CSU2	0.52	0.2695	1.03	0.31	1.14	0.34
CSU3	0.21	0.0419	0.36	0.22	-1.07	0.82
CSU4	0.44	0.1903	0.83	0.26	-0.61	0.30

Item CSU3 was eliminated, as it had a factorial load lesser than 0.3 and discrimination parameter lesser than 0.65. The new values are shown in Table 3.

Table 3. EFA and IRT results after deleting item CSU3.

Item	Load (F1)	h2	a	SE(a)	b	SE(b)
CRE1	0.689	0.475	1.62	0.40	0.43	0.18
CRE2	0.708	0.502	1.71	0.41	0.04	0.16
CRE3	0.550	0.303	1.12	0.30	0.23	0.21
CRE4	0.834	0.695	2.57	0.70	0.88	0.17
CRE5	0.827	0.683	2.50	0.62	0.24	0.14
CRE6	0.597	0.356	1.27	0.35	1.08	0.28
CAV1	0.598	0.358	1.27	0.36	1.21	0.31
CAV2	0.732	0.536	1.83	0.45	0.47	0.17
CAV3	0.658	0.433	1.49	0.37	0.42	0.18
CAV4	0.845	0.714	2.69	0.81	1.15	0.20
CAP1	0.609	0.371	1.31	0.38	1.33	0.32
CAP2	0.553	0.306	1.13	0.37	1.75	0.47
CAP3	0.760	0.578	1.99	0.48	0.09	0.15
CAP4	0.369	0.136	0.68	0.27	1.85	0.71
CSU1	0.598	0.358	1.27	0.33	-0.20	0.19
CSU2	0.515	0.265	1.02	0.31	1.14	0.34
CSU4	0.434	0.188	0.82	0.26	-0.61	0.30

The values of Cronbach's alpha (0.84), McDonald's omega (0.92), KMO (0.81) and p-value of Bartlett's test (p=2 * 10-49) were not affected by the exclusion of item CSU3. The measures of fit were RMSEA = 0.059, TLI = 0.944 and CFI = 0.951, indicating a relatively good model–data fit in general. The test information and the standard error curves are shown in Fig. 2.

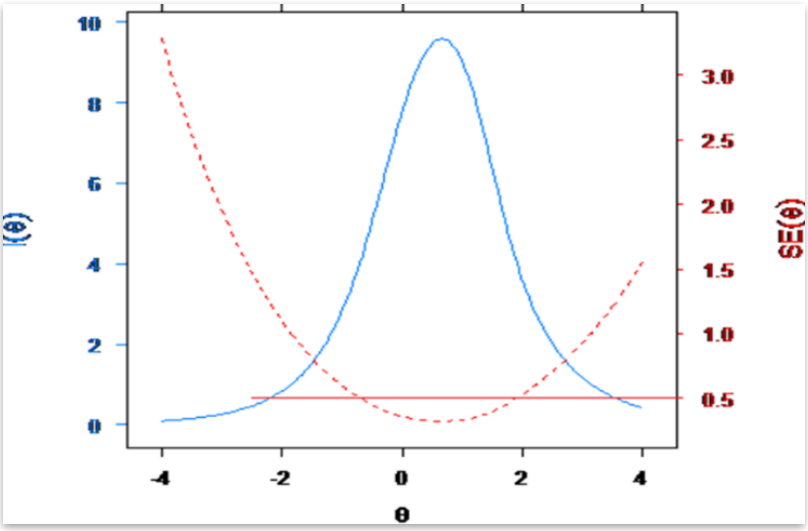

Fig. 2. Test information and Standard Error Curves.

The test information is concentrated in the central region of the scale. The standard error of the procedural switching cost estimates is below 0.5 in the region of -0.5 and 2.0. For scale interpretation, it was divided into intervals of 1 in 1 standard deviation, from -1 to 3 and the items were positioned at the level where the probability of answer 1 exceeded 0.5 (Table 4).

Table 4. Probabilities of positive answers for positioning Items in Scale

Procedural Exchange Costs (Scale (0,1))							
Item	**a**	**b**	**-1**	**0**	**1**	**2**	**3**
CTPCSU4	0,82	-0,61	0,42	0,62	0,79	0,89	0,95
CTPCSU1	1,27	-0,20	0,27	0,56	0,82	0,94	0,98
CTPCRE2	1,71	0,04	0,15	0,48	0,84	0,97	0,99
CTPCAP3	1,99	0,09	0,10	0,46	0,86	0,98	1,00
CTPCRE3	1,12	0,23	0,20	0,44	0,70	0,88	0,96
CTPCRE5	2,50	0,24	0,04	0,36	0,87	0,99	1,00
CTPCAV3	1,49	0,42	0,11	0,35	0,70	0,91	0,98
CTPCRE1	1,62	0,43	0,09	0,33	0,71	0,93	0,98
CTPCAV2	1,83	0,47	0,06	0,30	0,72	0,94	0,99
CTPCRE4	2,57	0,88	0,01	0,09	0,58	0,95	1,00
CTPCRE6	1,27	1,08	0,07	0,20	0,47	0,76	0,92
CTPCSU2	1,02	1,14	0,10	0,24	0,46	0,71	0,87
CTPCAV4	2,69	1,15	0,00	0,04	0,40	0,91	0,99
CTPCAV1	1,27	1,21	0,06	0,18	0,43	0,73	0,91
CTPCAP1	1,31	1,33	0,05	0,15	0,39	0,71	0,90
CTPCAP2	1,13	1,75	0,04	0,12	0,30	0,57	0,80
CTPCAP4	0,68	1,85	0,13	0,22	0,36	0,52	0,68

4 distinct groups are observed from the positioning of the items: relationships with SC below zero, 0<=SC<1, 1<=SC<2 and SC>=2 (table 5)

Table 5. Levels of Procedural Switching Costs

Level	Itens	Responses
Minimum	None	65
Medium	CSU1, CSU4	41
High	CRE1, CRE2, CRE3, CRE4, CRE5, CAV2, CAV3, CAP3	12
Maximun	CRE6, CAV1, CAV4, CAP1, CAP2, CAP4, CSU2	2

4 Discussion and Conclusions

The scale created allow us to differentiate 4 groups of procedural switching costs (PSC). At the lowest level (minimum), it is easier to change suppliers. Responses to all items tend to be negative. At this level, there were 65 responses (54%).

From 0 to 1, the PSC increase a little, moving to the medium level. At this level, the process of switching to a new transport service provider takes time and involves several formalities (items CSU1 and CSU4). 41 surveyed companies (34%) were at this level.

At the "high" level (between 1 and 2), the PSC are even greater, including, in addition to the above, the economic risks indicated by items CRE1 to CRE5, related to the risk of a lower service level offered by the alternative transport providers involving unexpected inconveniences and unplanned costs. In addition, there are evaluation costs indicated by items CAV2 and CAV3, related to the time and effort necessary to obtain information on the new suppliers and evaluate the benefits arising from the exchange. There are also learning costs related to the relationship with the new supplier, indicated by item CAP3. In the sample, 12 companies (10%) were at this level.

Finally, there were found 2 cases (2%) at the maximum level (PSC above 2), in which all items categories of switching costs are included. In addition to the above mentioned, there is uncertainty regarding the elements involved in the relationship with the new transport service provider (item CRE6). There are also the evaluation costs indicated by items CAV1 and CAV4, related to the difficulty and lack of information to evaluate the new supplier. New learning costs also can arise, namely those related to difficulties in using the resources offered by the new supplier and the team's willingness to understand such resources (items CAP1, CAP2 and CAP4). Finally, changing transport service providers represents an unpleasant business process (item CSU2).

In this study, IRT was used for the development of an interpretable scale that supports the understanding of procedural switching costs resulting from interorganizational buyer-supplier relationships between food and beverage companies and transport service providers. As a result, four levels of procedural switching costs were identified: minimum, medium, high and maximum.

The cases analyzed are divided by the 4 levels proposed for the scale, with the majority concentrated at the minimum one, which refers to the lowest supplier switching cost. This means that the surveyed food and beverage companies can change their suppliers incurring relatively low costs. Thus, transport providers should use strategies to increase the buyers switching costs, as a way of retaining them (food companies) in the current interorganizational relationship. The buyers of this IOR, i.e., the food and beverage companies, must analyze the trade-off between a stronger and longer partnership with suppliers, and the corresponding dependency and switching costs, and a low level of compromise and dependency which represent a low level of switching costs. Both have advantages and disadvantages and result more effective and efficient according to each company and the relevant contextual variables.

For further research, it can be suggested the application of IRT to the other dimensions of switching costs (i.e., relational and financial), as a way to assess the multidimensionality of the construct. Furthermore, the application of the instrument can be made in other interorganizational contexts, since the behavior of switching costs may differ from service to product and among different industries. Furthermore, other switching costs taxonomies discussed in the literature can be used to redefine the proposed construct. Finally, instead of IRT, it can be used other techniques to structure the scales.

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