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MODELING THE EFFECT OF BELIEF REVISIONS ON THE SUCCESS OF CO-BRANDING

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Abstract:
This paper provides a normative guideline regarding the successful formation of co-branding alliances for both academic researchers and practitioners. We use the expectancy-value model to quantify the mechanism of belief revision in co-branding. Starting from this, an existing mathematical model is adapted in order to investigate (1) the influence of belief revisions on the necessary condition of a successful co-branding alliance (i.e., a sufficient amount of required expansion for the partnering brands) and (2) the existence of an ideal situation that ensures the success. The resulting propositions show that belief revisions can affect a brand's intention with respect to a co-branding partnership. A simulation study demonstrates that an ideal situation exists when the partnering brands are similar in the magnitude of customers' belief revision, brand reputation, and customer loyalty. The present paper advances existing knowledge by relating the success of co-branding partnerships to consumer evaluations. Managerial implications and future research directions are also discussed.

Keywords: Belief revision, success of co-branding, consumer evaluations, mathematical modelling in marketing

JEL Classification: M31

1. Introduction

Over the past two decades co-branding has become an increasingly prevailing strategy for brand managers to leverage existing brand equities [e.g., the *Sony-Ericsson* mobile]. But 40 percent of these strategic alliances failed over a period of four years [cf. Doorley, (1993)]. Since consumer evaluation (i.e., attitudes and attribute beliefs) is regarded as the most important factor determining the success of co-branding [e.g., James, (2005), Hadjicharalambous, (2006)], most of the previous work has utilized the "attitudinal acceptance" of the co-brand and the allying (or partnering) brands [e.g., Simonin and Ruth, (1998), Desai and Keller, (2002), Rodrigue and Biswas, (2004), Walchli, (2007)] to measure the effectiveness of co-branding. However, analyzing the success of co-branding from this behavioural perspective has a critical limitation: the strategic intent (or interest) of a brand to form such an alliance is not fully considered.

To close this research gap, two economic theories – the signaling theory [e.g., Spence, (1973)] and the theory of inter-organizational exchange [e.g., Cook, (1977)] – have been applied to explain the function of the brand name [e.g., Rao and Ruekert, (1994), Rao *et al.*, (1999)] and to discuss the mutual benefits derived from the partnership, respectively [e.g., Bucklin and Sengupta, (1993), Venkatesh *et al.*, (2000)]. In this light, the term "success of co-branding" can be referred to as a "successful (alliance) formation" [Venkatesh *et al.*, (2000)]. However, analyses from this strategic (alliance) perspective are relatively scarce. Thus, the present study attempts to embellish the limited discussions in this field. In particular, we are going to incorporate a basic element in consumer evaluations, namely "attribute belief", which is considered an important aspect of the success of co-branding [Hillyer and Tikoo, (1995)] but the connection between the two has not yet been built up by marketing researchers.

Venkatesh *et al.* (2000)'s work is a good starting point for this purpose. From a strategic point of view, they provided a comprehensive analysis by considering both the effects of signaling and inter-organizational exchange. They assumed that a dynamic co-branding alliance is established to signal each brand's functional expertise. Furthermore, they claimed that the emergence of consumers' "preference change" between the allying brands (i.e., "shift-in preference") is indispensable, because preferences are considered to be the resource owned by each of the brands to be exchanged in the partnership. They argued that, eventually, the two players considered may have an endogenous competition on preferences and thus a certain amount of market expansion for the weak player is

required. Their study offers valuable insights into alliance success but disregards the behavioural contents (in particular the revision of attribute beliefs) behind "shift-in preference".

In comparison with Venkatesh *et al.* (2000), the present study addresses the mechanism of "belief revisions" in co-branding and examines the relation between belief revisions and the successful formation of a co-branding alliance. Accordingly, this paper aims to answer the following two questions:

(1) How can the belief revisions affect the necessary condition for a successful formation?

(2) Does an ideal situation exist that generally ensures a success?

By answering these questions the paper contributes to co-branding research in three ways. First, to the best of our knowledge, it is the first to build up a formal connection between the success of co-branding and consumer evaluations. Further, the present paper provides the rationales behind positive and negative belief revisions in co-branding. Finally, we use a mathematical modeling approach to analyze the relevant relations [Moorthy, (1993)], which is still less prevalent in this field [Huber, (2005)].

The remainder of this paper is organized as follows: Section 2 reviews the relevant literature. Then, in Section 3 we provide a brief description of the Venkatesh *et al.* (2000) model and formulate the mechanism of belief revisions in co-branding. Section 4 adapts the Venkatesh *et al.* (2000) model to offer two propositions regarding the impacts of the negative belief revisions on the necessary condition, and applies the analytical results to visualize the existence of an ideal situation by means of a simulation study. Section 5 finally discusses managerial implications as well as future research directions.

2. Related literature

2.1 Belief revisions in co-branding

Consumers' belief revision (i.e., belief dilution and enhancement) regarding the parent brands is a key issue in brand extension research. Existing studies report that, depending on category similarity or image consistency between the original and the extended products [Grime *et al.*, (2002)], the revision on the pre-extension beliefs about attribute (performance) levels can be negative or positive [e.g., Loken and Roedder John, (1993), Milberg, (2001)]. Indeed, the above process is related to the model of accommodation [Park *et al.*, (1993)]: consumers adapt their pre-extension beliefs to the new levels when they receive new but incongruent attribute information from the extended products. Since co-branding has been recognized as a sub-case of brand extension [Hadjicharalambous, (2006)], belief revisions can also occur when consumers evaluate the co-brand. However, different from brand extension, belief revisions in co-branding can be caused by the partnership [Hillyer and Tikoo, (1995)]. James (2005) further stated that belief revisions may result from the inconsistent attribute information of the co-brand and that incongruence may be the result of different perceptions of the allying brands. Recently, Geylani *et al.* (2008) concluded that the attribute levels of the allying brands can be enhanced, but attribute uncertainty may even be increased after co-branding. In sum, belief revisions in co-branding are also related to the accommodation model but the process is more complicated.

2.2 A specific type of co-branding alliance

This study focuses on a specific type of co-branding, namely the "functional co-branding alliance" [Cooke and Ryan, (2000)], which is established in order to offer a joint (or co-branded) product by integrating the advantageous product-related attributes from each of the allying brands. Before the alliance, both brands produce their products at the same step in the value chain within the same product category, and each brand can be distinguished by different attribute levels. In this aspect, the considered type of partnership is close to co-branding line extension [*cf.* Hadjicharalambous, (2006)]. In the following, we use two dimensions to categorize this type of alliance. The first dimension concerns the intended period and the number of new product releases; the second dimension deals with the purpose of the alliance [Desai and Keller, (2002)]. As shown in Table 1, the one to be analyzed in this paper is short-to-mid term cooperation with several new product releases by modifying the attribute levels of existing attributes of both brands (e.g., a co-branded pizza mixing existing attributes "good-taste" and "low-calories").

Table 1. A categorization of functional co-branding alliances

			Line extension	
			Modifying existing attributes	Adding new attributes
Intended period of alliances/No. of new product releases	Short-to-mid Term	Single release	An opera CD featuring *Paul Plishka* and *Placido Domingo* (mixing "Tenor" with "Bass" of male voice)	A one-time opera concert featuring *Placido Domingo* and *Whitney E. Houston* (mixing "male" with "female" voice)
		Multiple releases	Several releases of co-branded pizzas from brands *Appetite* and *Bio* (mixing "good-taste" with "low-calories")	A series of CDs featuring *Placido Domingo* and Whitney E. Houston
	Long term (usually a joint-venture)		*Fujitsu-Siemens*' PC products	*Sony-Ericsson*'s W-series music phones (adding *Sony*'s "Walkman" function)

Note: indicates the particular co-branding partnership to be analyzed in this paper.

3. An extension to Venkatesh *et al.* (2000)

3.1 Key elements of the Venkatesh *et al.* (2000) model

By referring to the Bass (1969) diffusion model, Venkatesh *et al.* (2000) built up a dynamic framework to investigate the necessary condition of alliance success. In this model, two brands *A* and *B* are the prospective partners in a mid-term co-branding alliance. Initially, at time $i = 1$ (with $i = 1,2,3,\ldots,I$) the market comprises two consumer segments of sizes $M_{A(1)}$ and $M_{B(1)}$ that prefer brand *A* and *B*, respectively. In the baseline situation (i.e., before the alliance is formed), each consumer at segment *A* (*B*) is assumed to adopt the product $J_{A(i)}$ ($J_{B(i)}$) at time *i*, and hence the potential market size for $J_{R(i)}$ is $M_{R(i)}$, where $M_{R(i)} = M_{R(1)}$ (*R* denotes brands with $R = \{A, B\}$).

If the alliance is in effect (see Fig. 1), it will release the *i*-th joint product $J_{AB(i)}$ at time *i* and each of the consumers who prefer *A* or *B* are assumed to adopt one unit of $J_{AB(i)}$ (accordingly, the total market size is at least $M_{A(1)} + M_{B(1)}$) during the intermediate period between time *i* and *i+1*. The authors further argued that, at time *i*+1, the consumers initially belonging to segment *A* (*B*) may change their preference to *B* (*A*) due to their consumption experiences from $J_{AB(i)}$. Therefore, the segment size of *A* can change from $M_{A(i)}$ to $(1-S_{AB})\times M_{A(i)} + S_{BA}\times M_{B(i)}$ and the segment size of *B* can change from $M_{B(i)}$ to $S_{AB}\times M_{A(i)} + (1-S_{BA})\times M_{B(i)}$, where S_{AB} and S_{BA} represent the proportions of consumers who shift their preference from *A* to *B* and from *B* to *A*, respectively (i.e., the shift-in ratios).

The Venkatesh *et al.* (2000) study is based on four main assumptions: (1) the segment are not overlapping and each consumer prefers only one brand at each time point, (2) the consumers will not shift their preferences to a third player within the relevant periods, (3) the shift-in ratios are modeled as time-independent variables, and (4) each of the players will split the (sales) revenue of the joint products according to its share of preference at each time point.

The authors further reported that, eventually, the share of preference will change from $M_{R(1)}/(M_{A(1)} + M_{B(1)})$ at the beginning of the alliance to an equilibrium level (hereafter, the equilibrium share) of $S_{BA}/(S_{AB} + S_{BA})$ for *A* and $S_{AB}/(S_{AB} + S_{BA})$ for *B*. That is, one of the brands can be a loser in the partnership when its equilibrium share is smaller than its initial share. In other words, the weak brand has to acquire more consumers from outside the alliance (requiring a certain amount of market expansion) to maintain its original revenue level. This type of market expansion is

regarded as the necessary condition for the successful formation. As a consequence thereof, the alliance may break up if the anticipated amount of expansion is not forthcoming. The sufficient amount of required expansion, denoted by ΔM_{V}, is expressed as [Venkatesh *et al.*, (2000)]:

$$\Delta M_{\mathrm{V}} \geq Max\left\{ M_{A(1)}\left(\frac{S_{AB}}{S_{BA}}\right) - M_{B(1)}, M_{B(1)}\left(\frac{S_{BA}}{S_{AB}}\right) - M_{A(1)} \right\}, \text{ for } S_{AB}, S_{BA} \neq 0. \qquad (1)$$

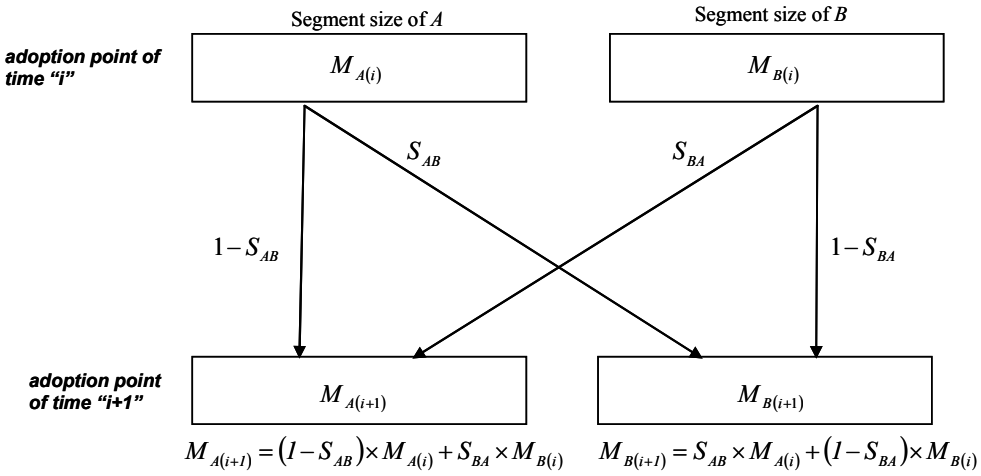

Figure 1. The evolution of alliance according to Venkatesh *et al.* (2000)

3.2 An extended model

We keep the above assumptions (1), (2), and (4) but additionally consider the shift-in ratio as a function of parameters that capture the mechanism of belief revisions. In the following we concretize this mechanism and re-examine equilibrium shares as well as the necessary condition for the successful formation.

3.2.1 Aspects of the market structure

At time *i*, each of the brands either releases its own product $J_{R(i)}$ or cooperates with each other for launching the *i*-th joint product $J_{AB(i)}$. Initially, the market comprises two segments of sizes $M_{R(1)}$ ($M_{R(1)} > 0$) that prefer *A* and *B*, respectively. Different from Venkatesh *et al.* (2000), we name the initial members of segment *A* (*B*) group *a* (*b*) and assume that *a* (*b*) is more familiar with *A* (*B*) than *B* (*A*) within the relevant time periods. In the broader sense group *a* (*b*) can be viewed as the loyal customers of *A* (*B*). If we use $M_{R(1)}^{G}$ to denote the size of group *G* (*G* = {a, *b*}), i.e. the members staying with brand *R* at time 1, then $M_{A(1)} = M_{A(1)}^{a}$ and $M_{B(1)} = M_{B(1)}^{b}$ holds.

Figure 2 once more illustrates the sequence of events according the above descriptions. The adapted model will specify the events that occur during the intermediate period between the first and second time points.

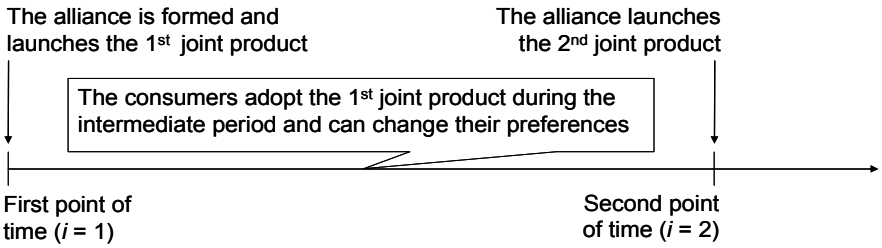

Figure 2. The sequence of events

In the following sections, we will deal with three types of attribute beliefs: (1) the pre-alliance (i = 1) beliefs of the partnering brands (hereafter, the pre-alliance beliefs), (2) the beliefs of the "first" co-branded product (hereafter, the co-branding beliefs), and (3) the post-alliance (i = 2) beliefs of the partnering brands (hereafter, the post-alliance beliefs).

3.2.2 Formation of initial preferences

We apply the expectancy-value model [Bass and Talarzyk, (1972), Fishbein and Ajzen, (1975)] to formulate preferences because it has been widely recommended for explaining preference formation [Agarwal and Malhotra, (2005)]. Two relevant product-related attributes, called x and y, are used to characterize brand A and B. The preference of group G at time i is formulated as a relative score composed of group G's relative weights of attribute importance $w^{K,G} > 0$ (K denotes attributes and $K = \{x, y\}$) and group G's belief of each attribute of each brand $P_{R(i)}^{K,G} > 0$ (for notational simplicity, we will not specify each element for the sets K, G, and R in the remaining of this paper). Group G's preference $\Phi_{R(i)}^{G}$ for each brand can be expressed as:

$$\Phi_{R(i)}^{G} = \sum_{K} w^{K,G} \times P_{R(i)}^{K,G} \,. \tag{2}$$

Practically, $w^{K,G}$ can be measured by asking a representative sample of consumers to divide 100 points between the two attributes, according to how important each attribute is to them. The number of points assigned to each attribute can be used as an indicator of the relative importance of that attribute [Wilkie and Pessemier, (1973); Mackenzie, (1986)]. Besides, $P_{R(i)}^{K,G}$ can be represented by the perceived levels that a specific attribute possesses [Wilkie and Pessemier, (1973)] and can be measured by rating scores in a fixed interval [e.g., from 0 to 100, see Geylani *et al.*, (2008)].

Let us further assume that the consumers belonging to different groups have identical pre-alliance beliefs (i.e., $P_{R(1)}^{K,G} = P_{R(1)}^{K}$ holds) and that attribute x is salient to A whereas y is salient to B. Hence, the initial attribute level of x (y) of A (B) can be assumed to be larger than the initial (i = 1) level of x (y) of B (A) [Geylani *et al.*, (2008)], i.e., $P_{A(1)}^{x} > P_{B(1)}^{x}$ and $P_{B(1)}^{y} > P_{A(1)}^{y}$. Besides, let D^{K} denote the initial attribute-level difference of attribute K between A and B, i.e., $D^{x} = P_{A(1)}^{x} - P_{B(1)}^{x}$ and $D^{y} = P_{B(1)}^{y} - P_{A(1)}^{y}$.

Furthermore, the differences of each attribute are assumed to be the same, i.e. $D = D^{x} = D^{y}$ applies. The above assumption is motivated by referring to Geylani *et al.* (2008, p.736), who also assumed an equal attribute-level difference in their experiment conditions. A positive initial attribute-level difference indicates a better product fit (in terms of attribute complementarily) [Park *et al.*, (1996), Geylani *et al.*, (2008)] but, however, also presents inconsistent attribution information to the consumers [Park *et al.*, (1996)]. Group G's relative weight of attribute importance of attribute K is quantified as $w^{K,G} \in (0,1)$ and we use the different relationships of $w^{K,G}$ to capture the between-group heterogeneity:

$$w^{x,a} > w^{y,a}, \text{ with } \sum_{K} w^{K,a} = 1, \tag{3}$$

$$w^{y,b} > w^{x,b}, \text{ with } \sum_{K} w^{K,b} = 1 \,. \tag{4}$$

That is, group *a* considers *x* to be more important, and group *b* concerns *y* more. Assuming that group *G* prefers the brand with the highest score, Eq. (2) to (4) can explain why group *a* (*b*)'s initial preference is *A* (*B*): $\Phi^{a}_{A(1)} > \Phi^{a}_{B(1)}$ and $\Phi^{b}_{B(1)} > \Phi^{b}_{A(1)}$.

3.2.3 Mechanism of belief revisions

A functional co-branding alliance has two effects on consumer evaluations: (1) the inconsistent attribute information causes confusions about the true levels of the co-branded products [Park *et al.*, (1996), Geylani *et al.*, (2008)] and (2) consumers use the co-branding beliefs to modify their pre-alliance beliefs [James, (2005), Geylani *et al.*, (2008)]. Both effects will be discussed in this subsection. The co-branding beliefs $J_{AB(1)}$ can be modelled as:

$$P^{x}_{AB(1)} = \lambda^{x}_{A} \times P^{x}_{A(1)} + \lambda^{x}_{B} \times P^{x}_{B(1)} + \varepsilon, \text{ where } \lambda^{x}_{R} \in [0,1] \text{ and } \sum_{R} \lambda^{x}_{R} = 1, \quad (5)$$

$$P^{y}_{AB(1)} = \lambda^{y}_{A} \times P^{y}_{A(1)} + \lambda^{y}_{B} \times P^{y}_{B(1)} + \varepsilon, \text{ where } \lambda^{y}_{R} \in [0,1] \text{ and } \sum_{R} \lambda^{y}_{R} = 1. \quad (6)$$

That is, by the theory of information integration [Anderson, (1981)], the pre-alliance beliefs are integrated into the co-branding beliefs [James, (2005), Geylani *et al.*, (2008)]. Therefore, in Equation (5) and (6), λ^{K}_{R} denotes the relative contributing weight of each attribute of each brand to the co-branding beliefs. Besides, a random term ε is added to represent the confusions about the true attribute levels (i.e., attribute uncertainty) of the first co-branded product. Hence, the co-branding beliefs are represented by the weighted average of the pre-alliance beliefs plus the confusion ε, which is assumed to be uniformly distributed on the interval $[-\theta, \theta]$. In a similar context, Geylani *et al.* (2008) also assumed that beliefs are symmetrically distributed around the mean. The symmetry of the co-branding beliefs [Equations (5) and (6)] is managed by assuming that the parameters of the uniform distributions are the "additive inverses" of each other. Besides, the uniform distribution is utilized to easily obtain analytical results on the shift-in ratios (i.e., $S^{a}_{AB(1)}$ and $S^{b}_{BA(1)}$).

Moreover, we assume that $\theta(D)$ is strictly increasing in *D* because confusions are positively related to the magnitude of the initial attribute-level difference [Geylani *et al.*, (2008)], i.e.,

$$\theta = \theta(D) = \delta D, \quad (7)$$

holds, where $\delta \in (0, 1/2)$ is a confusion parameter. Here, the upper limit of δ ensures that both *x* of *A* and *y* of *B* have a negative revision (see Equations (13) and (16)) and both *y* of *A* and *x* of *B* have a positive revision [see Equations (14) and (15)]. The rationale behind the negative and positive revisions will be provided in section 4.1.

If we posit that both brands contribute the same (i.e., λ^{K}_{R} = 1/2) to the co-branding beliefs, Equations (5) and (6) can be rewritten as

$$P^{x}_{AB(1)} = \frac{1}{2}\left(P^{x}_{A(1)} + P^{x}_{B(1)}\right) + \varepsilon, \quad (8)$$

$$P^{y}_{AB(1)} = \frac{1}{2}\left(P^{y}_{A(1)} + P^{y}_{B(1)}\right) + \varepsilon. \quad (9)$$

Assuming an equal attribute-level difference, $P^{K}_{AB(1)}$ in Equations (8) and (9) can be transformed into

$$P^{x}_{AB(1)} = P^{x}_{A(1)} - \frac{1}{2}D + \varepsilon = P^{x}_{B(1)} + \frac{1}{2}D + \varepsilon\,, \tag{10}$$

$$P^{y}_{AB(1)} = P^{y}_{A(1)} + \frac{1}{2}D + \varepsilon = P^{y}_{B(1)} - \frac{1}{2}D + \varepsilon\,. \tag{11}$$

Finally, the post-alliance beliefs of group *G* can be formulated as

$$P^{K,G}_{R(2)} = \gamma^{K,G}_{R} \times P^{K}_{AB(1)} + \left(1 - \gamma^{K,G}_{R}\right) \times P^{K}_{R(1)}, \text{ where } \gamma^{K,G}_{R} \in [0,1]. \tag{12}$$

Equation (12) is inspired by Geylani *et al.* (2008) and, accordingly, the updating weights $\gamma^{K,G}_{R}$ can be used to determine the degree of revision on each attribute of each brand over groups. Substituting $P^{K}_{AB(1)}$ from Equation (10) and (11) into Equation (12) yields the following relations which show the belief revisions of each attribute of each brand for each group:

$$P^{x,G}_{A(2)} = P^{x}_{A(1)} - \frac{1}{2}\gamma^{x,G}_{A} D + \gamma^{x,G}_{A}\varepsilon\,, \tag{13}$$

$$P^{y,G}_{A(2)} = P^{y}_{A(1)} + \frac{1}{2}\gamma^{y,G}_{A} D + \gamma^{y,G}_{A}\varepsilon\,, \tag{14}$$

$$P^{x,G}_{B(2)} = P^{x}_{B(1)} + \frac{1}{2}\gamma^{x,G}_{B} D + \gamma^{x,G}_{B}\varepsilon\,, \tag{15}$$

$$P^{y,G}_{B(2)} = P^{y}_{B(1)} - \frac{1}{2}\gamma^{y,G}_{B} D + \gamma^{y,G}_{B}\varepsilon\,. \tag{16}$$

3.2.4 Shift-in ratios

Assuming $S^{a}_{AB(1)}$ to be the probability of group *a*'s consumers shifting their preferences from *A* to *B* after having consumed the first joint product:

$$S^{a}_{AB(1)} = Pr\left(\Phi^{a}_{B(2)} > \Phi^{a}_{A(2)}\right), \text{ where } Pr(\bullet) \text{ is a suitable probability function,} \tag{17}$$

and, by substituting $\Phi^{a}_{R(i)}$ in Equation (17) by Equation (2), we get

$$S^{a}_{AB(1)} = Pr\left(w^{x,a}P^{x,a}_{B(2)} + w^{y,a}P^{y,a}_{B(2)} > w^{x,a}P^{x,a}_{A(2)} + w^{y,a}P^{y,a}_{A(2)}\right). \tag{18}$$

Similarly, $S^{b}_{BA(1)}$ denotes the probability of preference change for group *b* and is expressed as

$$S^{b}_{BA(1)} = Pr\left(\Phi^{b}_{A(2)} > \Phi^{b}_{B(2)}\right). \tag{19}$$

By replacing $\Phi^{b}_{R(i)}$ in Equation (19) by Equation (2), we get

$$S^{b}_{BA(1)} = Pr\left(w^{x,b}P^{x,b}_{A(2)} + w^{y,b}P^{y,b}_{A(2)} > w^{x,b}P^{x,b}_{B(2)} + w^{y,b}P^{y,b}_{B(2)}\right). \tag{20}$$

Indeed, $S^{a}_{AB(1)}$ and $S^{b}_{BA(1)}$ also represent the expected shift-in ratios of group *a* and *b*, respectively, because consumers belonging to the same group behave identically.

3.2.5 Equilibrium shares and necessary condition

Since we formulate the shift-in ratio as a function, our dynamical structure is different from Venkatesh *et al.* (2000) (cf. Figure 1). Figure 3 shows this dynamics. According to our setting, from *i* = 2, each segment consists of the members from *a* and *b*, two sub-segments (e.g., $M_{A(2)} = M^{a}_{A(2)} + M^{b}_{A(2)}$ and $M_{B(2)} = M^{a}_{B(2)} + M^{b}_{B(2)}$). Hence, our model can be considered to have two independent dynamical systems – the evolutions of *a* (i.e., the state variables are $M^{a}_{A(i)}$ and $M^{a}_{B(i)}$) and *b* (i.e., the state variables are $M^{b}_{A(i)}$ and $M^{b}_{B(i)}$).

For example, as shown in Figure 3, the evolution of *a* during the second intermediate period (i.e., between time 2 and time 3) can be explained as follows: A proportion $S^{a}_{AB(2)}$ of the $M^{a}_{A(2)}$ consumers shift their preference to *B* while the remaining $\left(1 - S^{a}_{AB(2)}\right) \times M^{a}_{A(2)}$ consumers still stay with *A*. By the same token, a proportion $S^{a}_{BA(2)}$ of the $M^{a}_{B(2)}$ consumers change their preference to *A* and a total amount of $\left(1 - S^{a}_{BA(2)}\right) \times M^{a}_{B(2)}$ consumers stay with *B*. Finally, $M^{a}_{A(3)}$ and $M^{a}_{B(3)}$ will equal $\left(1 - S^{a}_{AB(2)}\right) \times M^{a}_{A(2)} + S^{a}_{BA(2)} \times M^{a}_{B(2)}$ and $S^{a}_{AB(2)} \times M^{a}_{A(2)} + \left(1 - S^{a}_{BA(2)}\right) \times M^{a}_{B(2)}$, respectively. The above process builds up also during the third intermediate period and hereafter. Therefore, to derive the equilibrium share of each brand, the steady states of $M^{a}_{A(i)}$, $M^{b}_{A(i)}$, $M^{a}_{B(i)}$, and $M^{b}_{B(i)}$ must be identified.

We now assume that initially two brands are equally reputed in terms of the segment size [Venkatesh *et al.*, (2000)], so $M_{A(1)} = M_{B(1)} = M$ holds. The equal level of reputation will be relaxed later in the simulation study. Besides, we assume that the belief revision is a one-shot event that occurs only when the customers adopt the first joint product (i.e., between time 1 and time 2). This assumption is based on the need of parsimony and the lack of a theoretical and empirical confirmation in the literature: we found that previous studies in co-branding discuss the belief revision only from the aspect of "static updating" {i.e., pre- and post-alliance; see [Hillyer and Tikoo, (1995), James, (2005), Geylani *et al.*, (2008)]}.

Based on the second assumption, the attribute level of each attribute of each brand will be fixed at *I* = 2 and, by applying Equations (18) and (20), $S^{a}_{AB(1)} = S^{a}_{AB(i)} = \left(1 - S^{a}_{BA(i)}\right)$ and $S^{b}_{BA(1)} = S^{b}_{BA(i)} = \left(1 - S^{b}_{AB(i)}\right)$ hold if $i \geq 2$. Hence, the equilibrium of $M^{a}_{A(i)}$, $M^{a}_{B(i)}$, $M^{b}_{A(i)}$, and $M^{b}_{B(i)}$ will be reached at time 2: The steady state of $M^{a}_{A(i)}$ and $M^{a}_{B(i)}$ is $\left(1 - S^{a}_{AB(1)}\right) \times M$ and $S^{a}_{AB(1)} \times M$, respectively, whereas the steady state of $M^{b}_{A(i)}$ and $M^{b}_{B(i)}$ is $S^{b}_{BA(1)} \times M$ and $\left(1 - S^{b}_{BA(1)}\right) \times M$, respectively. Finally, the equilibrium of $M_{A(i)}$ and $M_{B(i)}$ is $\left(1 - S^{a}_{AB(1)} + S^{b}_{BA(1)}\right) \times M$ and $\left(S^{a}_{AB(1)} + 1 - S^{b}_{BA(1)}\right) \times M$, respectively, and thus the equilibrium share is $\left(1 - S^{a}_{AB(1)} + S^{b}_{BA(1)}\right) / 2$ for *A* and $\left(1 + S^{a}_{AB(1)} - S^{b}_{BA(1)}\right) / 2$ for *B*. So, following the logic of Venkatesh *et al.* (2000, p.25), the amount of required expansion will be at least $\left[2 / \left(1 - S^{a}_{AB(I)} + S^{b}_{BA(I)}\right) - 2\right] \times M$ for *A* (denoted by ΔM_A) and $\left[2 / \left(1 + S^{a}_{AB(I)} - S^{b}_{BA(I)}\right) - 2\right] \times M$ for *B* (denoted by ΔM_B). The proof of the amount of required expansion is available from the first author upon request. Accordingly, the necessary condition for the successful co-branding alliance (denoted by ΔM) reads

$$\Delta M \geq Max\left\{\left[2 / \left(1 - S^{a}_{AB(I)} + S^{b}_{BA(I)}\right) - 2\right] \times M, \left[2 / \left(1 + S^{a}_{AB(I)} - S^{b}_{BA(I)}\right) - 2\right] \times M\right\}. \quad (21)$$

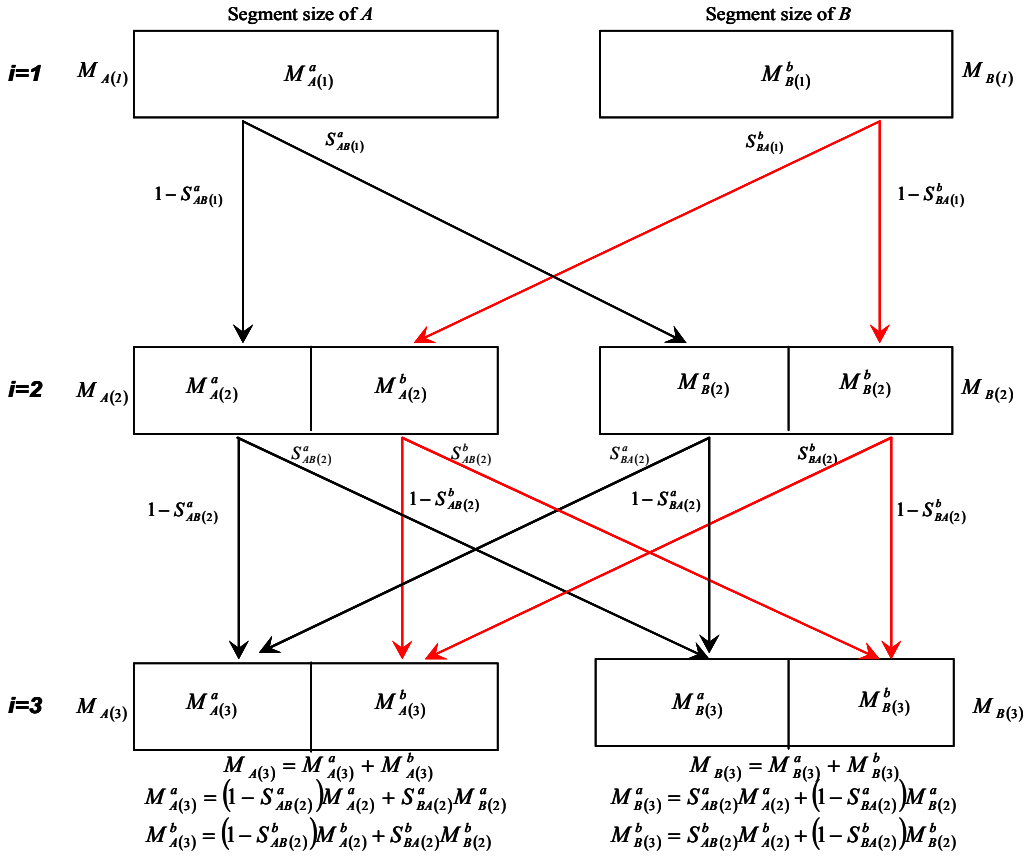

Figure 3. The evolution of alliance from time $i = 1$ to time $i = 3$

4. Propositions and simulation study

4.1 Propositions

Let us now get back to the shift-in ratios. Then, by substituting $P^{K,a}_{R(2)}$ ($P^{K,b}_{R(2)}$) from Equation (13) through (16) into Equation (18) and Equation (20), we obtain

$$S^a_{AB(1)} = Pr\left\{w^{x,a}D\left[\frac{1}{2}\gamma^{x,a}_A + \frac{1}{2}\gamma^{x,a}_B - 1\right] + w^{y,a}D\left[1 - \frac{1}{2}\gamma^{y,a}_A - \frac{1}{2}\gamma^{y,a}_B\right]\right.$$
$$\left. > \varepsilon\left(w^{x,a}\left(\gamma^{x,a}_A - \gamma^{x,a}_B\right) + w^{y,a}\left(\gamma^{y,a}_A - \gamma^{y,a}_B\right)\right)\right\}, \quad (22)$$

$$S^b_{BA(1)} = Pr\left\{w^{x,b}D\left[1 - \frac{1}{2}\gamma^{x,b}_A - \frac{1}{2}\gamma^{x,b}_B\right] + w^{y,b}D\left[-1 + \frac{1}{2}\gamma^{y,b}_A + \frac{1}{2}\gamma^{y,b}_B\right]\right.$$
$$\left. > \varepsilon\left(w^{x,b}\left(\gamma^{x,b}_B - \gamma^{x,b}_A\right) + w^{y,b}\left(\gamma^{y,b}_B - \gamma^{y,b}_A\right)\right)\right\}. \quad (23)$$

Let μ denote the ratio of relative weights of attribute importance (or consumer taste over the two attributes, [Hauser and Shugan, (1983)]) and suppose the following condition holds:

$$\mu = \left(w^{x,a}/w^{y,a}\right) = \left(w^{y,b}/w^{x,b}\right). \quad (24)$$

Note that the equal ratio of two groups is a benchmark and will be relaxed later in the simulation study. By Equations (3) and (4), Equation (24) implies

$$\mu > 1. \quad (25)$$

Equation (22) to (25) can now be used for proving some useful propositions.

Now we define the term "negative (positive) belief revisions". Compared with the pre-alliance beliefs of x (y) of A (B), the joint product is perceived to have a poorer attribute performance (cf. Equations (10) and (11)). Through the process of "accommodation" (see section 2.1), the pre-alliance beliefs about these two specific attributes may be diluted due to the inconsistency between the existing beliefs and the co-branding beliefs. We call this type of updating behaviour a "negative (belief) revision" [cf. Equations (13) and (16)]. On the contrary, a "positive (belief) revision" may exist [cf. Eq. (14) and (15)] on the pre-alliance beliefs about y (x) of A (B), because, in contrast to the pre-alliance beliefs of y (x) of A (B), the co-branded product is perceived to provide a better attribute performance. The above arguments also echo the result in Geylani *et al.* (2008) (see Fig. 1 in [Geylani *et al.*, (2008)]).

Besides, brand familiarity has been recognized as an important factor of moderating the belief (or attitude) updates [e.g., Simonin and Ruth, (1998), Sheinin, (2000), Grime *et al.*, (2002)], and therefore we discuss the impact of belief revisions under the following two cases.

Case 1: The consumers of each group are more sensitive to changes of the pre-alliance beliefs of their originally preferred brand.

Case 1 is inspired by Grime *et al.* (2002), who have inferred that a consumer with a higher level of familiarity with one brand tends to update that brand's initial beliefs *more* when she (he) receives inconsistent information from the (co-branded) extended products. Mathematically speaking, this implies

$$\gamma_A^{K,a} > \gamma_B^{K,a} \text{ and} \tag{26}$$

$$\gamma_B^{K,b} > \gamma_A^{K,b}. \tag{27}$$

Proposition 1 (2) illustrates the influence of *negative* revisions under the assumption of Case 1: When A (B)'s customers have a relative large negative updating on A (B), Proposition 1 and 2 can exist simultaneously.

Proposition 1: *Under certain conditions ($\gamma_A^{y,a} = \mu\gamma_B^{x,a}$ and $1 \geq \gamma_A^{x,a} > \gamma_A^{y,a} > \gamma_B^{x,a} > \gamma_B^{y,a} > 0$), brand A needs a larger amount of market expansion to form the alliance, ceteris paribus, when the difference between $\gamma_A^{x,a}$ and $\gamma_B^{y,a}$ increases.*

The intuition behind Proposition 1 is that group a's relatively large negative revision on brand A can decline A's intention (or interest) for (in) the alliance. Fig. 4 shows that when the customers of A (i.e., group a) have a relatively larger amount of negative revision on A than B, the pre-alliance belief of x of A will be diluted more. Consequently, a larger portion of A's customers will shift their preference to B after co-branding. As argued by Venkatesh *et al.* (2000), A eventually has to require a relatively large amount of expansion for entering this partnership. Such a condition is a weak prospect for A.

Proof. By using Eq. (24) and (26), Eq. (22) can be rearranged as

$$S_{AB(1)}^{a} = Pr\left[\frac{w^{y,a}D\left(\frac{1}{2}\mu\gamma_A^{x,a} + \frac{1}{2}\mu\gamma_B^{x,a} - \mu + 1 - \frac{1}{2}\gamma_A^{y,a} - \frac{1}{2}\gamma_B^{y,a}\right)}{w^{y,a}\left(\mu\gamma_A^{x,a} - \mu\gamma_B^{x,a} + \gamma_A^{y,a} - \gamma_B^{y,a}\right)} > \varepsilon\right]. \tag{28}$$

By canceling out $w^{y,a}$ and assuming $1 \geq \gamma_A^{x,a} > \gamma_A^{y,a} > \gamma_B^{x,a} > \gamma_B^{y,a} > 0$ and $\gamma_A^{y,a} = \mu\gamma_B^{x,a}$, Eq. (28) can be rewritten as

$$S^{a}_{AB(1)} = Pr\left[D\left(\frac{1-\mu}{\mu\gamma^{x,a}_{A} - \gamma^{y,a}_{B}} + \frac{1}{2} \right) > \varepsilon \right]. \tag{29}$$

If we use ρ to represent $\left(\gamma^{x,a}_{A} - \gamma^{y,a}_{B}\right)$, Equation (29) can be expressed as follows:

$$S^{a}_{AB(1)} = Pr\left\{ D\left[\frac{1-\mu}{(\mu-1)\left(\rho + \gamma^{y,a}_{B}\right) + \rho} + \frac{1}{2} \right] > \varepsilon \right\}. \tag{30}$$

Furthermore, letting L be the term $D\left[\frac{(1-\mu)}{(\mu-1)\left(\rho + \gamma^{y,a}_{B}\right) + \rho} + \frac{1}{2} \right]$, we get $S^{a}_{AB(1)} = Pr(L > \varepsilon)$. Since ε is uniformly distributed on the interval $[-\theta, \theta]$, we get

$$S^{a}_{AB(1)} = (L + \theta)/2\theta, \quad \text{for } -\theta < L < \theta\ . \tag{31}$$

Since $\partial S^{a}_{AB(1)} / \partial L > 0$ and $\partial L / \partial \rho > 0$,

$$\partial S^{a}_{AB(1)} / \partial \rho > 0\,. \tag{32}$$

The anticipated market expansion for brand *A* to forge the alliance (ΔM_{A}) is at least

$$\left[\frac{2}{1 - S^{a}_{AB(1)} + S^{b}_{BA(1)}} - 2 \right] M\,. \tag{33}$$

If all the other variables are fixed in Equation (33), one can easily confirm that the amount of anticipated expansion for *A* will increase as $\rho = \gamma^{x,a}_{A} - \gamma^{y,a}_{B}$ becomes larger. Q. E. D.

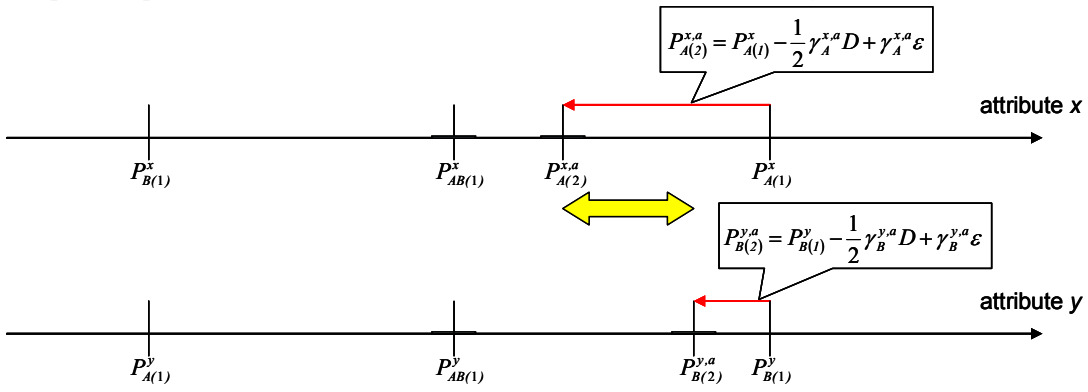

Figure 4. The negative revision of group *a*

Proposition 2: *Under certain conditions* ($\gamma^{x,b}_{B} = \mu\gamma^{y,b}_{A}$ *and* $1 \geq \gamma^{x,b}_{B} > \gamma^{y,b}_{B} > \gamma^{x,b}_{A} > \gamma^{y,b}_{A} > 0$), *brand B needs a larger amount of expansion to form the alliance, ceteris paribus, when the difference between* $\gamma^{y,b}_{B}$ *and* $\gamma^{x,b}_{A}$ *increases.*

The intuition of Proposition 2 is analogous to Proposition 1: group *b*'s relatively large negative revision on brand *B* can decline brand *B*'s interest in this partnership. The proof of Proposition 2 is available from the first author upon request because it is very similar to that of Proposition 1.

Obviously, due to the complexity of the process of belief revisions in co-branding, a quantitative prediction of the outcome of a co-branding partnership is only possible by applying the suggested modeling framework.

Case 2: The consumers of each group do not easily change the pre-alliance beliefs of their originally preferred brand.

Case 2 is contrary to Case 1 and is motivated by Sheinin (2000). Mathematically speaking, it implies

$$\gamma_A^{K,a} < \gamma_B^{K,a} \text{ and} \tag{34}$$

$$\gamma_B^{K,b} < \gamma_A^{K,b}. \tag{35}$$

Under this case, we can also offer two propositions to show the influences of the relative degree of positive revisions on each brand's intention for a partnership. But, since the argumentation is analogous to Proposition 1 and 2, details are skipped here but available from the first author upon request.

From brand manager's perspective, it might be interesting to get a sense of the amount of required expansions for both brands and to check when the required expansion is unlikely to occur [cf. Venkatesh *et al.*, (2000)]. Some simple simulations can serve this need.

4.2 Simulation study

A hypothetical co-branding alliance, formed by brands *Appetite* (*A*) and *Bio* (*B*), is used as an example in the following. The two equally reputed brands are assumed to release several co-branded pizzas, *Appetite-Bio*, on the market. At the beginning of the alliance, *Appetite* (*Bio*) has one group of loyal customers, group *a* (*b*), who are more familiar with *Appetite* (*Bio*) than *Bio* (*Appetite*). The two brands are assumed to be evaluated by two product-related attributes "good-taste" (*x*) and "low-calories" (*y*). Initially, *Appetite* (*Bio*) has a relatively high perceived attribute level on "good-taste" ("low-calories") while *Bio* (*Appetite*) has a relatively low level on the same attribute. This co-branding alliance also presents a better product-fit to the consumers (cf. section 3.2.2). As mentioned in section 3.2.3, after co-branding, the belief of "good-taste" ("low-calories") of *Appetite* and the belief of "low-calories" ("good-taste") of *Bio* will receive a negative (positive) revision.

Starting from the above scenario we will simulate the influences of group *a*(*b*)'s negative revisions on brand *A*(*B*)'s intention regarding a partnership simultaneously (which corresponds to the combination of Proposition 1 and 2). That is, we will utilize *a*'s updating weight of *x* of *A* ($\gamma_A^{x,a}$) and *b*'s updating weight of *y* of *B* ($\gamma_B^{y,b}$) as a set of input variables[1] and observe the corresponding changes of the necessary condition for the successful formation (i.e., the amount of required expansion, ΔM).

In short, the following three scenarios will demonstrate how the necessary condition for the successful formation is affected by the difference of the negative belief revisions between *Appetite* and *Bio* (caused by each brand's loyal customers). Furthermore, we also discuss the existence of an ideal situation.

Scenario 1 assumes that two groups have the same structure of parameters. Scenario 2 and 3 will relax the assumptions in our mathematical model (by assigning different parameter values over the two groups). By offsetting these limitations, our results will be become more robust and realistic.

Proposition 1 is used as an example to show how we select the value for each parameter. Actually, we separate the parameters involved in Proposition 1 into two categories. The first category is called the "brand characteristics" and is composed of the initial segment size of brand *A* ($M_{A(1)}$),

[1] To simulate Proposition 1, we let $\gamma_B^{y,a}$ be a parameter and employ $\gamma_A^{x,a}$ as the input variable to choose different values of $\rho = \gamma_A^{x,a} - \gamma_B^{y,a}$. Analogously, to simulate Proposition 2, we fix the value of $\gamma_A^{x,b}$ and use $\gamma_B^{y,b}$ as the input variable to select different values of $\gamma_B^{y,b} - \gamma_A^{x,b}$.

the pre-alliance beliefs ($P^K_{R(1)}$), the initial attribute-level difference (D), and the co-branding beliefs ($P^K_{AB(1)}$). The second category is named the "consumer characteristics" and includes the relative weight of attribute importance ($w^{K,a}$), the confusion parameter (δ), and the updating weights ($\gamma^{K,a}_R$, excluding the variable $\gamma^{x,a}_A$).

For ease of calculation, we let $M_{A(1)}$ = 100 (for notational simplicity, hereafter we drop the time index of the market size in this section). $P^x_{A(1)}$ and $P^y_{B(1)}$ are set to 80 whereas $P^y_{A(1)}$ and $P^x_{B(1)}$ are set to 46 (the values are selected by referring to the experimental results of Geylani *et al.*, (2008, p.739). Moreover, according to Equation (8) and (9), $P^K_{AB(1)}$ is formulated as the sum of the midpoint between 46 and 80 and confusions. For the "consumer characteristics" category, the value of each parameter is chosen from a set. By Equations (3) and (24), μ is chosen from the set {1.1, 1.2, 1.3 and 1.4}.[2] Besides, δ is selected from the set {0.3, 0.333, 0.367, 0.4}.[3] Finally, to have a different range for ρ, we let $\gamma^{x,a}_A$ (hereafter, the negative updating weight of *A*) be the input variable and let $\gamma^{y,a}_B$ (hereafter, the negative updating weight of *B*) be a parameter chosen from the set {0.1, 0.2, 0.3}.

Note that for Proposition 1 (or Proposition 2) we will have 48 different examples (or different types of updating behaviours) if we use all combinations of the parameter sets listed above. Details about the 48 examples are available from the first author upon request.

4.2.1 Scenario 1: identical structure of parameters

This scenario shows the evolution of required expansion when the two groups have the same value for all the parameters, i.e., the same type of updating behaviour. In doing so, it will be more straightforward to visualize how the relative magnitude of each group's negative revisions ($\gamma^{x,a}_A$ and $\gamma^{y,b}_B$) influences the successful formation. Details on the parameters are provided in Table 2. Note that we exclude the cases where the values of $\gamma^{x,a}_A$ ($\gamma^{y,b}_B$) are smaller than 0.38, because in those cases the corresponding shift-in ratio is 0 and thus is out of consideration [cf. Venkatesh *et al.*, (2000)]. This setting also holds in scenario 2 and 3. Besides, we use our notations to replicate the simulations by Venkatesh *et al.* (2000) [see Figure 2A in Venkatesh *et al.*, (2000)] in Figure 5A and show the result of scenario 1 in Figure 5B. In addition, ΔM, is expressed as a percentage of the initial aggregated size of *Appetite* and *Bio* in Figure 5 (also Figure 6 and Figure 7). Details about the input and output variables in Figure 5 (also Figure 6 and Figure 7) are available from the first author upon request.

Venkatesh *et al.* (2000) showed that, when an equal shift-in ratio of both brands exists, i.e., if $S_{AB(1)} = S_{BA(1)}$ (presented by the black bullet points in Figure 5A) holds, each brand's "equilibrium share" (revenue) remains the same as initial levels and thus no brands act as a loser. We call this case an ideal situation (i.e., without required expansion, ΔM = 0). Our model addresses the importance of belief revisions: an ideal situation can only exist when the magnitude of the negative revisions of *Appetite*'s customer on *Appetite* and *Bio*'s customers on *Bio* is the same (i.e., $\gamma^{x,a}_A = \gamma^{y,b}_B$, presented by the black bullet points in Figure 5B). In brief, if the updating behaviour of both groups is the same, a similar magnitude of belief revisions can prevent both brands from being worse off in the alliance, thus achieving a successful formation.

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[2] As mentioned in section 4.1 μ can also represent different levels of consumer taste over the two attributes. Since we do not want to address extreme consumer tastes, smaller values are considered.

[3] To select the values of the confusion parameter properly, we refer to Geylani et al. (2008), who showed that the standard deviation of consumers' confusion is reasonable between 5.88 and 7.85. We map those values into our setting and thus δ can be chosen from the set {0.3, 0.333, 0.367, 0.4} (i.e., the standard deviation of ε is equal to $(\delta D)/\sqrt{3}$, see Eq. (7)).

Table 2. Details on the parameters in Figure 5B

Group *a*	M	μ	δ	$\gamma_B^{y,a}$	$\gamma_A^{x,a}$
	100	1.4	0.4	0.1	[0.38, 1]
Group *b*	M	μ	δ	$\gamma_A^{x,b}$	$\gamma_B^{y,b}$
	100	1.4	0.4	0.1	[0.38, 1]

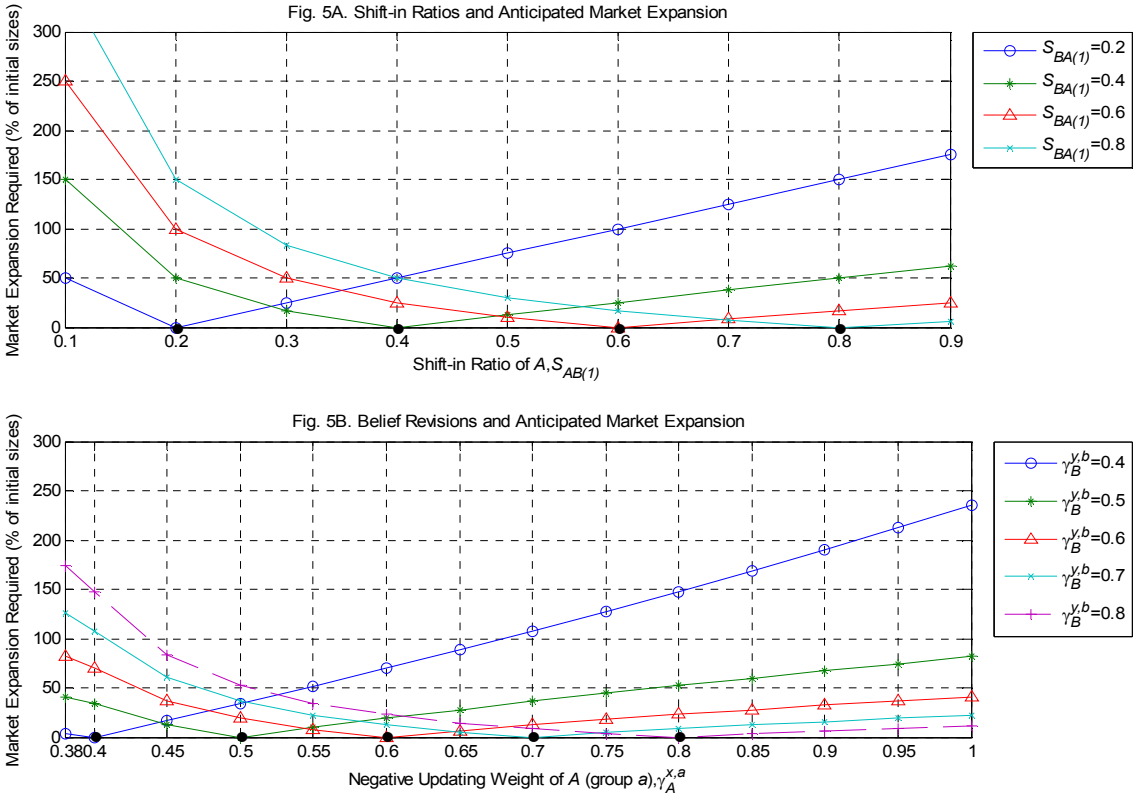

Figure 5. The evolution of anticipated market expansion

4.2.2 Scenario 2: different initial segment sizes

This scenario illustrates the evolution of required expansion when the allying brands' reputations are different (i.e., $M_{A(1)} \neq M_{B(1)}$, ceteris paribus). Details on the parameters are provided in Table 3. Figure 6 demonstrates the evolution of the amount of required expansion. In this scenario, an ideal situation does not exist (i.e., the respective curve does not reach the bottom line)[4] for the following conditions: $\gamma_B^{y,b} \geq 0.7$ in Figure 6A, $\gamma_B^{y,b} \geq 0.6$ in Figure 6B, and $\gamma_B^{y,b} \geq 0.5$ in Figure 6C.

[4] In Fig. 6 and 7, the curves with a kink (e.g., $\gamma_B^{y,b} \leq 0.6$ in Fig. 6A) are reaching the bottom (i.e., an ideal situation exist). However, we cannot always reach this specific point (e.g., for $\gamma_B^{y,b} = 0.4$, $\gamma_A^{x,a}$ is around 0.40387 in Fig. 6A) because the values of $\gamma_A^{x,a}$ are chosen with a step size of 0.05.

Table 3. Details on the parameters in scenario 2

Group *a*	M_A	μ	δ	$\gamma_B^{y,a}$	$\gamma_A^{x,a}$
	{75, 50, 25}	1.4	0.4	0.1	[0.38, 1]
Group *b*	M_B	μ	δ	$\gamma_A^{x,b}$	$\gamma_B^{y,b}$
	100	1.4	0.4	0.1	[0.38, 1]

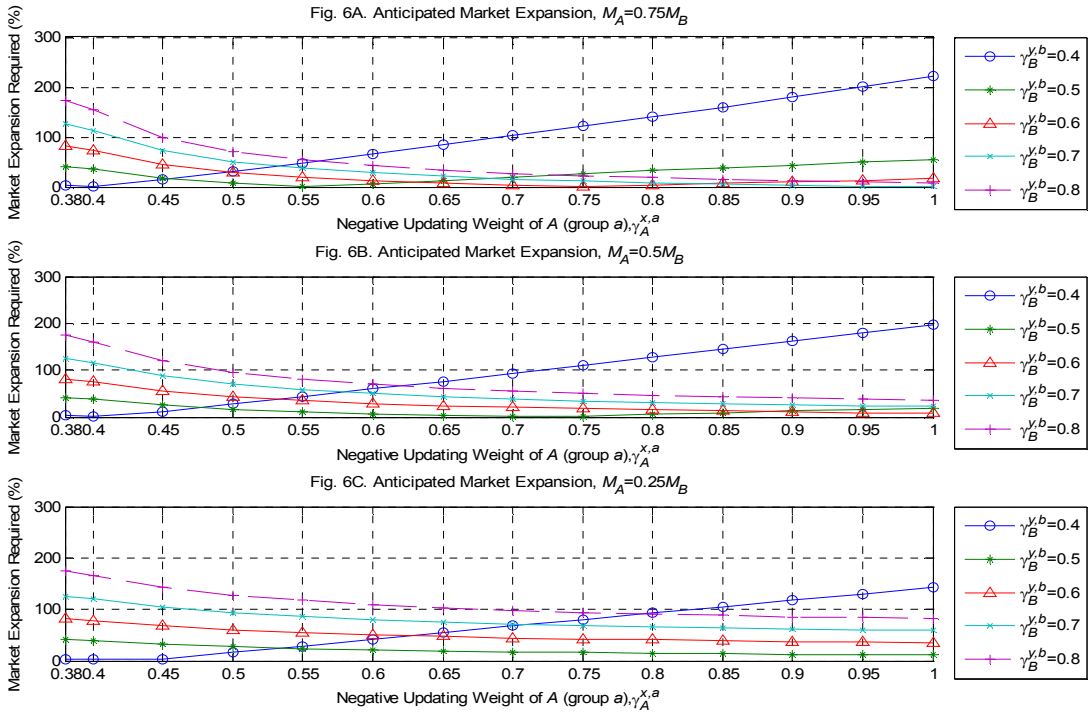

Figure 6. Results for scenario 2 (different initial segment sizes)

The non-existence of an ideal situation can be attributed to the incompatible brand reputations. For instance, when *Bio*'s customers have a considerable negative update on *Bio* (e.g., $\gamma_B^{y,b} \geq 0.6$ in Figure 6B), the equilibrium share of *Bio* in the alliance is always smaller than its initial level of 66.7%. Eventually, *Bio* must expand its market size if it partners with *Appetite*. On the other hand, *Appetite* benefits from the alliance as it can always achieve its initial preference share of 33.3%. Hence, this alliance is not appealing to *Bio* and it would definitely make a retreat. Thus, we can conclude that it is better for *Appetite* and *Bio* to have the same level of "reputation" because this helps both brands acquire a sufficient share from the alliance. In addition, a compatible brand reputation can also be thought of as one type of the "similar resource endowment" [cf. Bucklin and Sengupta, (1993)] since we assume that firms consider consumer preferences as the resource to be exchanged in a partnership.

4.2.3 Scenario 3: different relative weights of attribute importance

In Scenario 3, we allow the customers of *Appetite* and *Bio* to have different ratios of relative weights (i.e., $\mu^a \neq \mu^b$, ceteris paribus). By using the expectancy-value model, a larger ratio of relative weights may contribute to a higher level of attitudinal favorability of one brand (*cf.* Eq. (2) and (24)) and, as a consequence thereof, a higher degree of brand loyalty [Dyson *et al.*, (1996)]. So, the purpose of scenario 3 is to illustrate the evolution of required expansion when *Appetite*'s and *Bio*'s

customers have different levels of loyalty to *Appetite* and *Bio*, respectively. Table 4 shows details on the parameters in scenario 3, whereas Figure 7 presents the related simulation results. Similar to scenario 2, an ideal situation is not likely to occur in Figure 7B (when $\gamma_B^{y,b} \geq 0.7$) and in Figure 7C.

Table 4 - Details on the parameters in scenario 3

Group *a*	M	μ^a	δ	$\gamma_B^{y,a}$	$\gamma_A^{x,a}$
	100	1.4	0.4	0.1	[0.38, 1]
Group *b*	M	μ^b	δ	$\gamma_A^{x,b}$	$\gamma_B^{y,b}$
	100	{1.3, 1.2, 1.1}	0.4	0.1	[0.38, 1]

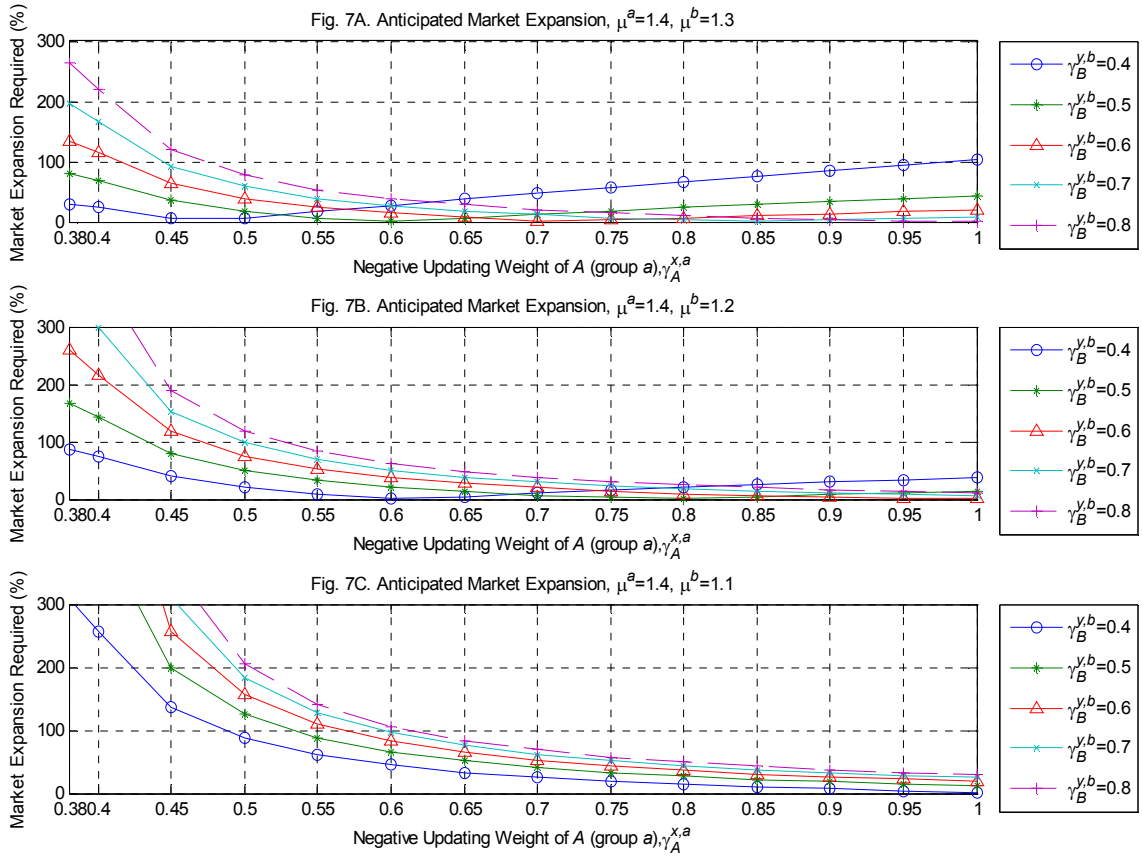

Figure 7. Results for scenario 3 (different relative weights of attribute importance)

In this scenario, the non-existence of an ideal situation is caused by the different levels of customer loyalty of *Appetite* and *Bio*. For example, *Bio* always loses a relatively large amount of its customers when, compared to *Appetite*, the loyalty level of its customers is relatively low (Figure 7C). In this case, *Bio* always has a shrinking equilibrium share (i.e., lower than 50%) if it allies with *Appetite*, and *Appetite* always dominates *Bio* by grabbing a larger equilibrium share (revenue) in the alliance. This might be a major reason for a failure of a partnership [Venkatesh *et al.*, (2000)]. Summing up, it is better for *Appetite* and *Bio* to have an equal level of customer loyalty.

5. Discussion

This paper provides normative guidelines for the successful formation of a co-branding alliance for both academic researchers and practitioners. Our results show that the relative magnitude of customers' belief dilutions on each of the allying brands ($\gamma_A^{x,a}$ and $\gamma_B^{y,b}$) may decline the partnering

brands' intentions to ally an alliance [cf. Equations (32) and (33)]. That is, a co-branding alliance may not be successfully formed even if the attribute complementarity exists (cf. section 3.2.2). Brand managers should also consider the more abstract level of consumer evaluations – namely belief revisions [cf. James, (2005)]. Our simulation study shows that the ideal situation can occur when both brands are similar with respect to the magnitude of customers' belief revision (scenario 1), brand reputation (scenario 2), and customer loyalty (scenario 3). In particular, we would like to emphasize the importance of a compatible "reputation" because it is related to a "free-riding" problem – a less-reputed brand may contribute less but gain more from its partner [e.g., Rao *et al.*, (1999]. In order to avoid this problem, brand managers should carefully check the quantity of loyal customers before initiating or entering a co-branding alliance. In addition, in order to achieve the same level of customer loyalty (μ), brand managers can use persuasive advertisements [Mackenzie, (1986)] to advocate the benefits brought by a specific attribute where one brand excels (e.g., *Appetite*'s good-taste or *Bio*'s low-calories).

There are three possible extensions to our work. First, we assume a static belief update. Future research can use the concept of "state dependence" in order to empirically test whether consumers have a dynamic updating behaviour [e.g., Erdem and Keane, (1996)] in the field of co-branding. Furthermore, we did not consider the theory of attitude accessibility [Fazio *et al.*, (1989)]. Park *et al.* (1996) have argued that an attribute with a larger salience can much easier be recalled from memory and can contribute more to the co-branding beliefs. In this case, the assumption that λ_R^x and λ_R^y are equal to $1/2$ should be relaxed. Finally, future research could measure the effectiveness of co-branding by the market performance. For example, a three-brand scenario – i.e., two allying brands and a competing brand – could be set up and the effects of belief revisions on the relative market share of the co-brand could then be examined. In doing so, we can offset an intrinsic limitation in our model – the customers of the allying brands' can also shift their preference to the competing brand and vice versa.

6. References

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