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Understanding the Dynamics of Alliance Capabilities

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Abstract

Strategic alliances have become important strategic options for firms to achieve competitive advantage. Yet, there are many examples of alliance failures. Scholars have studied this phenomenon and identified many reasons for alliance failure, including lack of trust between the partnering firms. Paradoxically, the concept of trust is still not fully understood, specifically how and under what conditions trust comes to break down within the broader process of alliance building. We synthesize a process model that describes the "alliance capability", including trust, openness, partner contributions, and relational rents. We then translate this framework into a formal simulation model and analyze it thoroughly. In analyzing trust dynamics we identify and explore a tipping boundary, separating a regime of alliance failures and successes. We apply our core findings to openness strategies – decisions about how much knowledge to share with partners. Our analyses reveal that strategies informed by a static mental model of trust, contributions, and openness, under undervalue openness. Further, too little openness risks early failure due to the being trapped in a vicious cycle of trust depletion.

Introduction

Strategic alliances have become an important strategic option for firms to achieve competitive advantage as they allow otherwise independent firms to share a variety of resources in interorganizational relationships (Anand & Khanna, 2000). Yet, despite their centrality to firms' success, history is filled with alliances that failed to live up to their expectations. Schreiner et al. (2009) identify this failure as a reason of lack of alliance management capability (Anand & Khanna, 2000) - the ability to coordinate, communicate, and bond among alliance partners (Schreiner et al., 2009). The latter primarily refers to trust. Lack of trust between the partners is regarded as a major reason for alliance failure (Gebrekidan & Awuah, 2002; Kale, Dyer, & Singh, 2002; Larsson, Bengtsson, Henriksson, & Sparks, 1998; Mohr & Puck, 2013; Park & Ungson, 2001). Trust plays a central role in managing alliances (Inkpen & Currall, 2004; Mohr & Puck, 2013), as in this context it can be considered as a type of expectation that alleviates the fear that the partner will act opportunistically and will fulfill its obligations in the relationship (Gulati, 1995; Kale et al., 2002). Therefore, its absence may lead to confusion about whether or not the alliance partner is committed and is actually an ally (Powell, Koput, & Smith-Doerr, 1996). Doubtful firms may thus simply prefer to end an alliance (Powell et al., 1996). Yet, paradoxically, despite being long-deemed critical to alliance success, the trust concept is still regarded as subtle,

diffuse, and elusive (Nooteboom, 1996). Specifically, we do not understand well how and under what conditions trust comes to break down or not in its contribution to alliance success.

The inability of managers to deal with trust cannot be traced to missing academic analyses about what affects trust. Trust is seen as multifarious, influenced by many constructs, including emotional bonds between people who work in the alliance partner companies (affect-based trust (McAllister, 1995)), reciprocal responding (personal trust (Luhmann, 1979)), sharing cognitions and common ways of thinking (cognitive trust (Lane, 1998)), the ability to perform according to an agreement (competence-based trust (Nooteboom, 1996)), past exchange (process-based trust (Zucker, 1986)), or by the way a firm and its members behave in an alliance, i.e., how open they are towards the partner or how reciprocally they act (behavioral-based trust (Inkpen & Tsang, 2005). The opennes that Inkpen and Tsang (2005) refer to, are communication skills in Schreiner et al.'s (Schreiner et al., 2009) concept of alliance management capability: through open and honest communication, a firm may reduce uncertainty about its motives and competences. Trust is fragile and has been recognized to evolve over the course of the alliance's existence (Inkpen & Currall, 2004) because of interactions of these constructs (Kumar & Nti, 1998). In general, trust tends to increase slowly (Glückler & Armbrüster, 2003) – however, it may only take a minor sign of cheating or untrustworthiness to destroy an arduously built-up relationship. Trust disseminates quickly in a cycle of distrust, and distrust emerges (Currall & Epstein, 2003; Inkpen & Currall, 2004). While we understand the factors that affect trust it is not clear how and under what conditions the collective interactions drive trust dynamics and alliance success.

The premise of this paper is that the missing piece to understanding the alliance-trust problem is an integrative approach appropriate to capture and clarify the multifaceted phenomenon of trust in alliances within the broader process of alliance building. Scholars have well accepted that alliances are dynamic systems (Ariño & de la Torre, 1998; Doz, 2002; Inkpen & Currall, 2004; Khanna, Gulati, & Nohria, 1998; Van De Ven & Poole, 1995). Yet, the specific role of trust as an emergent and evolving determinant in these dynamic organizational constructs has evaded developing a logically consistent theory. Child (2001), for example, referring to alliances, states that "trust remains an under-theorized, under-researched, and, therefore, poorly understood phenomenon" (p. 274). Specifically, the interplay between trust between the partner firms and the underlying complex interorganizational processes and the resulting dynamics is not fully investigated and hence not fully understood. One of the reasons for the lack of understanding might result from a limited human ability to reliably infer the behavior of even low-order dynamic systems (Booth Sweeney & Sterman, 2000). While the typical experimental study focuses on the ability of managers to control a dynamic process (Brehmer, 1992; Diehl &

Sterman, 1995; Sterman, 1989), the observation applies equally well to researchers trying to infer the dynamic consequences of their theories.

In this paper we explore trust dynamics in the context of alliances to develop an integrative theory of the development and drivers of trust between alliance partners that is built on the extant literature. To do this we, first, use causal loop diagramming (Sterman, 2000) to identify a feedback representation of trust dynamics. Drawing upon the literature we synthesize an internally-consistent and more parsimonious representation of the process of inter-organizational activities. We perform our theory development in two stages. We first consider the trust dynamics in isolation. Next we consider how trust interacts with other drivers necessary for alliance success, i.e. creating relational rent (Dyer & Singh, 1998). For this we focus on the context of learning alliances, an important class of interfirm alliances involving associations in which the primary objective of the partners is to learn with each other (Hamel, 1991; Hamel, Doz, & Prahalad, 1989). Yet, entering a learning alliance with a competitor not only provides the opportunity to learn with each other jointly, but also to learn from each other (Khanna, 1998). We identify three feedback processes – *Trust, Traveling trust*, and *Tit-for-tat* - that play central roles in governing the dynamics of alliances. We develop a computational representation of these processes and analyze their interactions through simulation. Simulation can be a powerful method for sharply specifying and extending extant theory in useful ways (Davis, Eisenhardt, & Bingham, 2007; Repenning, 2002). Simulation is particularly useful when the theoretical focus is longitudinal, nonlinear, or processual (Davis et al., 2007) The end result is an internally consistent theory that, while firmly grounded in previous work, moves beyond this in offering explanations of trust and alliance success and failure.

A number of insights emerge from our research. First, reviewing the literature from a feedback perspective highlights that central to understanding the role of trust in the development of alliances is a process involving a reinforcing feedback loop of trust, actor contributions, and alliance interactions. Second, our simulation experiments show that efforts to alliance success need to be much stronger than when seen from a static point of view. Specifically, our focus on a core construct, the degree of "openness" crystallizes these insights and underlies an internally consistent theory of how seemingly rational decision rules create the apparent paradox of alliances that provide optimal individual benefits early on, but fail to produce sustained benefit. Thus, while theorists have argued that alliances involve a complex dynamics process created by the interaction (e.g. (Inkpen & Currall, 2004)), this study takes another step forward by offering both an exact specification of the structures that comprise the trust in interorganizational dynamics and a precise characterization of how those structures interact with managerial actions.

Third, analysis of the simulation model demonstrates that the process of trust-building is embedded within the broader process of alliance management that can change from virtuous cycles that support the development of the alliance to vicious circles that work against a joint success. This process is embedded in the day-to-day activities of alliance building. Thus, besides the direct insights for managing alliances, our analysis reveals that trust dynamics form a special case of the capability trap (Repenning & Sterman, 2002). The capability trap results when a positive feedback involving investment into one's capabilities, acts as a vicious cycle, trapping organizational actors in a downward spiral of eroding capabilities. As actors fall short in their targets they are forced further towards working and away from improving. Such capability traps arise from interactions between judgmental biases and the physical structure of the processes. Specifically, in the context of alliances, this means that organizations can get stuck in an alliance capability trap of low trust. With eroded trust, organizations are less willing to contribute to the alliance and are less open towards the partner firm. Instead, actors may learn that it is increasingly effective to perform alliance-related tasks within each of the organizations separately, rather than collectively. As fewer and fewer resources are dedicated to develop or maintain the relations across the organizations, trust and overall alliance capability erodes further. While the capability trap dynamics point to the potential presence of a tipping point in alliance performance, its interorganizational nature suggest that the mechanisms may differ from those of traditional organizational capability traps. In particular, the involvement of two parties suggests added complexity of dynamics between success and failure.

While only simulation, the paper points to clear directions for further research, in particular avenues for empirical study. Using a computational model to demonstrate the linkage between assumptions and outcomes facilitates the development of an internally consistent theory (Davis et al., 2007; Mezias & Glynn, 1993; Repenning 2002). Further, with the dynamics of alliance failure being ill understood despite the identification of numerous relevant factors, our model offers a fruitful basis for further expansion. Given that such dynamics have so far received limited attention in this domain, additional complexity would, at this point, limit the ability to understand the core dynamics.

The remainder of the paper is organized as follows. In chapter 1 we present an integrative framework that captures the dynamic processes common to existing theories of alliance formation. In chapter 2 we develop and analyze a formal model of alliance formation between two organizations. In paragraph 4 we pursue an extension to the basic model, the asymmetry in expectations, goals, and behavior between two organizations within the alliance. In chapter 3 we show the limitations of this work and discuss implications for future research and practice.

Theory

Alliances are regarded as cooperative arrangements between economically independent companies that choose to carry out a project or operate in a specific business area by coordinating the necessary knowledge and resources jointly rather than operating on their own or merging their operations, while following common goals (Anand & Khanna, 2000; Dussauge, Garrette, & Mitchell, 2000; Khanna et al., 1998). Alliances are widely seen as a source of competitive advantage for firms (Dyer & Singh, 1998; Schreiner et al., 2009). Yet, alliances oftentimes fail (Anand & Khanna, 2000; Heidl, Steensma, & Phelps, 2014; Kale et al., 2002; Madhok & Tallman, 1998) with failure rates ranging between 50% (Dyer, Kale, & Singh, 2001) and 80% (Gulati, Khanna, & Nohria, 1994) of all alliances formed. The literature identifies a number of reasons for alliance failure, which can be subsumed under: (1) management deficiencies (Kale et al., 2002), including poor management and communication, lack of top management commitment, lack of complementary resources, changed priorities, management's short-term view, or cultural misfit; (2) insincere behavior by one of the partners, including opportunism, competitive rivalry, or one of the partners having won a learning race (Larsson et al., 1998); and, (3) a lack of trust between the parties (Park & Ungson, 2001). Lack of trust may lead to competitive confusion about whether or not the alliance partner is actually still an ally, and doubtful firms may prefer to end the alliance (Powell et al., 1996). Lacking trust contributes to alliance failure in 45% of alliances finished early (de Man & Duysters, w/o year) – in other words, the common objectives have not been reached.

It is thus crucial for managers to understand the concept of trust. Trust can be considered as a type of expectation that alleviates the fear that the partner will act opportunistically and will fulfill its obligations in the relationship (Gulati, 1995; Kale et al., 2002). Still, while trust has been identified as critical for alliance success, the role of trust in alliances is regarded as subtle, diffuse, and elusive (Nooteboom, 1996). In particular, the interplay of trust between partner firms and among their members and the underlying complex interorganizational processes and the resulting dynamics is not fully investigated.

Trust between alliances is highly dynamic. Like in any economic transaction, there is a minimum initial level of trust in alliances (Das & Teng, 2001). Trust evolves because of past interactions and gained experience with the alliance partner (Kumar & Nti, 1998) and develops slowly over the course of the alliance's existence (Glückler & Armbrüster, 2003). Whereas it takes a considerably long time and effort to build up trust, it may only take a minor sign of cheating or untrustworthy behavior to destroy an arduously built-up relationship. In such cases, trust between alliance partners disseminates quickly (Currall & Inkpen, 2002).

Reasons for alliance failure that are closely linked to insufficient trust include lack of commitment or reciprocity (Kogut, 1989), free riding (Dyer & Nobeoka, 2000; Oxley & Sampson, 2004), unequal sharing of risk and benefits (Büchel, 2003), unmet alliance expectations (Hagedoorn, Link, & Vonortas, 2000), and outlearning which might lead to a learning race (Hamel, 1991; Inkpen & Tsang, 2005; Larsson et al., 1998; Park & Ungson, 2001; Reich & Mankin, 1986) that undermines the shared alliance strategy. Referring to Schreiner et al's (Schreiner et al., 2009) definition of alliance capability, trust and reciprocity are central bonding skills. The willingness and ability of alliance partners to share knowledge and communicate openly with each other determine communication skills. Schreiner et al. (2009) state that "through open and honest communication, partners can better understand the obligations and engagement rules in the alliance" (p. 1401). They thus build shared mental models of how to work effectively together (Klimoski & Mohammed, 1994; Schreiner et al., 2009). We subsume these communication skills as organizational openness towards the alliance partner (Inkpen, 2000a). Openness can be linked to process-based trust (Inkpen & Tsang, 2005; Zucker, 1986) or character-based trust (Whipple & Frankel, 2000) because when members of one parent firm are open and behave with integrity toward the members of the partner firm, they seek to seem trustworthy. In other words, they seek to behave "according to agreement" (Nooteboom, 1996) – openly communicate and exchange and share knowledge – to achieve the common goals. Openness can thus be considered to be one form trust may take form of (Currall & Inkpen, 2002) (Nooteboom, 1996) and openness and trust are linked in a way that trust results in a decision to be (more) open to the partner.

Members of one parent firm expect their behavior to be reciprocated by the partner. In other words, if they are open towards the partner, they expect this behavior from its partner to be reciprocated (Das & Teng, 2002). In addition to the two skills mentioned, Schreiner et al.'s (Schreiner et al., 2009) concept includes coordination skills. These include the task interdependence between the partners. Alliance managers need to have appropriate interaction processes in place to manage an alliance throughout the relationship. While Schreiner et al. (2009) find evidence that an alliance capability consists of these three skills, they stand more or less side-by-side. In their recommendations for future research, they postulate that "it would be interesting to examine how a firm's alliance management capability influences its ability to learn effectively from the alliance partner" (p. 1413).

While there exists a relatively good understanding among scholars of the individual components of alliance capability, the interplay between trust between the partner firms and the underlying complex interorganizational processes including openness and task interdependence

and the resulting dynamics is not fully investigated and hence not fully understood. We shed light on these relationships in the following.

Trust Dynamics in Alliances

Effective alliance interactions produce the long term relational rents for the alliance partners (Dyer & Singh, 1998), (Figure 1, top right). Frequent and effective interactions between members of the alliance lead to knowledge flows between the firms, which is the basis for joint knowledge creation. However, effective alliance interactions are not pre-determined or exogenous features of alliance arrangements. Based on the above theory we hypothesize at the core effective interactions a reinforcing feedback process involving trust (Figure 1, R1 "*trust*").

Effective alliance interactions require contributions from both partners. Such contributions require trust, which encourages partners to contribute to further interactions – meetings between managers, engineers, or scientists - across them (Currall & Inkpen, 2002)as it is human nature for people who trust each other to wish to meet and interact more frequently with each other. Trust, in turn, builds up through effective interactions between the individuals of the partner firms in the alliance (Inkpen & Tsang, 2005; Nooteboom, 1996; Ring & van de Ven, 1992; Whipple & Frankel, 2000; Zucker, 1986) (Loop R1, right-hand side). When they interact frequently and openly share their knowledge, the members' mental models might adjust to each other, leading to a more common way of thinking (Child's (2001) and Lanes' (1998) cognitive trust) and sharing of common values (Child's (2001) and Lanes' (1998) normative trust). (Loop R1, left-hand side).

Effective interactions require not only both partners' presence but also their active provision of complementary resources (Klimoski & Mohammed, 1994; Schreiner et al., 2009). First, alliance rents often result from distinctiveness of contributions between the partners. Complementary resources between competitors that are required for joint learning from and with the partner is a widely acknowledged motive for companies to enter alliances (Child & Faulkner, 1998; Contractor & Lorange, 1988; Inkpen & Crossan, 1995). Second, alliance partners must be willing to openly share their private knowledge with one another. Hamel (1991) and Inkpen (2000a) identify such organizational openness as critical for the knowledge flow in the alliance (Figure 1, top left). Organizational openness can be understood as the willingness and ability of alliance partners to share knowledge and communicate openly with each other (Inkpen, 2000a). Openness thus supports information sharing and creating a shared mental model of how to work effectively with each other (Klimoski & Mohammed, 1994; Schreiner et al., 2009). Thus, openness between the alliance partners determines therefore the overall quality of knowledge exchange between the firms (Inkpen, 2000a).

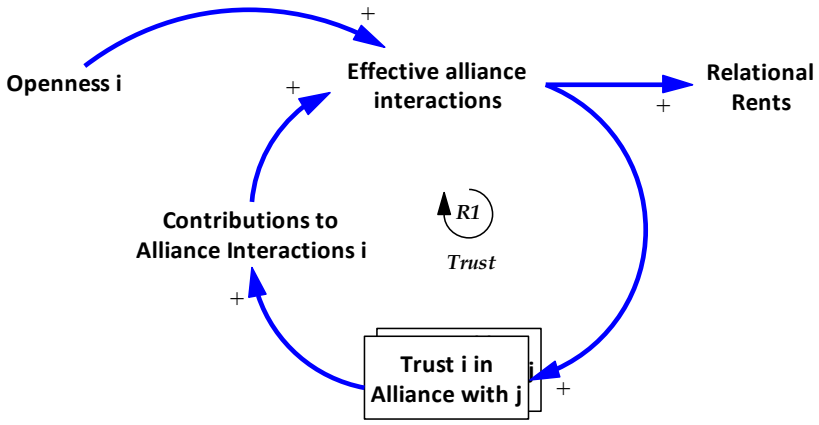

Figure 1: The self-reinforcing *trust* feedback process in alliances.

Openness, while critical for the functioning of the alliance involves however a large costs at the individual firm level. Possible spillover to the partner (private learning, as opposed to common learning) is regarded as an inevitable consequence of interfirm collaboration despite efforts to protect knowledge (Inkpen, 2000a). When knowledge spills over firms risk strengthening the alliance partner beyond the scope of the alliance. Such costs imply an important tradeoff in the benefit of openness which therefore is often managed as a strategic decision. Firms might be especially reluctant to open up towards a partner with which they enter an alliance, when the partner firm can also be seen as a competitor. For example, as observed by Hamel (1991) in his study on Japanese and American cooperative ventures, firms may reduce their openness while not sharing all the information necessary for building up a common knowledge base to work collectively on alliance tasks. Yet, trust dynamics complicates the leverage of such behavior. According to the members of the American partners, their Japanese partners were less open than themselves. Therefore, they had the feeling of being in a weaker position in the relationship and unfair behavior. If one partner is less open, knowledge exchange is hampered.

In our focus on trust dynamics in alliances we concentrate on the concept of openness as a strategic lever. We suggest that the interactions between trust and effective interactions on the one hand, and openness on the other have large implications for both alliance outcomes and the strategic leverage of openness.

We analyze this problem using simulation (e.g., (Mezias & Glynn, 1993; Sastry, 1997), we comment on its use in the following. The translation of verbal theory to a mathematical representation necessarily results in the loss of richness. There are, however, to corresponding benefits (Repenning, 2002; Sterman, 2000). First, a simulation enforces the internal consistency of the theory, ensuring that the behavior it purports to explain can in fact be generated by tis

underlying assumptions. Second, a simulation model provides a laboratory in which to discover implications of the theory's assumptions that are not intuitively obvious. We first develop the model of trust dynamics in alliances. After that we focus on a specific case of openness and how this interacts with trust dynamics.

Model of Trust Dynamics in Alliances

Model Specification

Effective alliance interactions, AI, increase with interactions across two partners, 1 and 2, with individual contributions to the interactions is captured through the vector $\vec{ia} = \{ia_1, ia_2\}$:

$$ia^e = f_{ia}\left(\vec{ia}\right); f_{ia}(\bullet)' \geq 0; f_{ia}(0) = 0; \quad (1)$$

The output from partners' respective contributions is not necessarily linear in their specific combinations. In some cases contributions are more substitutable than in others. We capture $f_{ia}(\ )$ through a classic CES production function. The CES production function introduces a similarity parameter $\rho \in [0,1]$ indicating the degree to which the contributions are substitutable (McFadden, 1980). Its interpretation is similar, but opposite, to the interdependence of tasks between alliance partners (Schreiner et al., 2009). Following the CES formulation, *f()* constructed as:

$$f_{ia}\left(\vec{ia}\right) = \left(ia_1^{\frac{1}{\rho}} + ia_2^{\frac{1}{\rho}} \right)^{\rho} \quad (2)$$

A value of ρ->1 implies respective partner contributions being substitutable to each other. Here, contribution similarity is high and interdependence low. In this case, partner contributions are simply additive capturing so that it does not matter much who contributes what – simply more contributions from each is better. By contrast, ρ->0 corresponds to situations in which partner contributions are perceived to be relatively dissimilar – hence, substitutability is low. For example, the partners have both specialized knowledge (i.e., patents) which is required for productive work on the alliance tasks. Thus, the tasks are not interchangeably. The relation 1-ρ can also be seen as corresponding with larger complexity of the alliance tasks.

Interactions ia_i simply multiplies a partner's contributions CO_i and its openness, OP_i:

$$ia_i = CO_i * OP_i \quad (3)$$

The level of contributions, or partner commitment to contribute, to the alliance interactions are a stock that increases through the influence of trust, captured through f_{trco}, but is subject to saturation, captured through f_{co},.

$$\frac{dCO_i}{dt} = g_{co}\left[f_{trco}\left(\frac{TR_i}{trn}\right) f_{co}\left(\frac{CO_i}{con}\right) - 1 \right] * CO_i; \quad f_{trco}(\bullet)' \geq 0; f_{co}(\bullet)' \leq 0; \tag{4}$$

This expression captures that when both influences – or pressures – are equal to 1, contributions to alliance interactions remain constant. Further, while the first influence has a positive slope, the second has a negative slope. Finally, the normal change rate of commitments is captured by the parameter g_{co}. Both relations are captured through symmetric S-shape functions with respectively inflection points at normal trust, *trn* and normal contributions *con*.

Trust is also a stock and is formulated in a similar way as contributions. However, in this case the pressures affecting the change rate of trust are the influence from effective interactions, f_{iatr} and saturation of trust f_{tr}:

$$\frac{dTR_i}{dt} = g_{tr}\left[f_{iatr}\left(\frac{ia^e}{ian}\right) f_{tr}\left(\frac{TR_i}{trn}\right) - 1 \right] * TR_i; \qquad f_{iatr}(\bullet)' \geq 0; f_{tr}(\bullet)' \leq 0; \tag{5}$$

Again, we formulate f_{iatr} here as a standard, symmetric, S-shaped function with respectively inflection points at normal interactions, *ian* and normal trust *trn*.

Finally, the relational rent, RR, accrued by the partners integrates the effective interactions over time:

$$\frac{dRR}{dt} = IA_e \tag{6}$$

In the now following analysis we treat openness as a constant, equal to 1. Hence we can ignore the role of openness. However, we relax this assumption in the model expansion that follows later in the paper.

Analysis

To characterize the range of behavior the system produces and to understand the impact of each of its parameters, the model has been extensively analyzed using a variety of assumptions and scenarios. Three sets of simulation experiments provide a useful introduction to the system's most interesting dynamics. In these simulations we assume that two firms enter an alliance to learn jointly with each other on specific alliance goals for about two years. The goals have been agreed on before the official alliance start. In the simulation, goals are achieved when relational rents *RR =1*, after which the alliance dissolves. For now we assume that both partner firms share resources including knowledge openly with each other. Hence openness $OP_i=1$ for both partners. We assume the simple case of high substitutability between contributions $(\rho = 1)$.

Consider first a symmetric situation – with both firms starting out with the same level of initial trust as well as having the same sensitivities to pressures. Further, trust starts out for both partners at its normal level ($TR_i=trn$), such that, initially, partners' contributions to the alliance

remain constant. With that, effective interactions are stable and, if at their normal rate, $ia^e_i = ian$, trust remains constant as well. The system is in dynamic equilibrium and the alliance produces stable rents, potentially on its way to meeting the long-term goals. Now we introduce a temporary exogenous shock to both partners' contributions to alliance interactions (ia_i), downward, by 10%. Figure 2a shows this, with the shock between week 5 and 10. A reason for this shock might be unanticipated resource constraints by one of the partner firms, for example. As a result of the downward shock, albeit temporary and small, the alliance members cannot work as effectively with each other as planned and effective interactions begin to decline. For the partners, noticing this, trust in the other slowly begins to deplete. As trust decreases, partners are less willing to contribute resources to the alliance than originally agreed upon. Thus, while trust begins to decline, so do the contributions and the effectiveness of the interactions, which further breaks down trust locking the alliance in a downward spiral of eroding trust and suppressed contributions. In this scenario relational rents are being created, but much less than originally strived for. The alliance goals are never met. The alliance can be interpreted as a failure.

By contrast, for the same alliance, an identical but upward temporary shock of 10% can set the alliance into a virtuous cycle of increasing trust and contributions (Figure 2b). The alliance partners perceive the alliance as successful and thus trust increases. The exponential growth of relational rents in Figure 2b is markedly different from that of Figure 2a. Relational rents reach their goals ($RR=1$) in week 34. The alliance is a success.

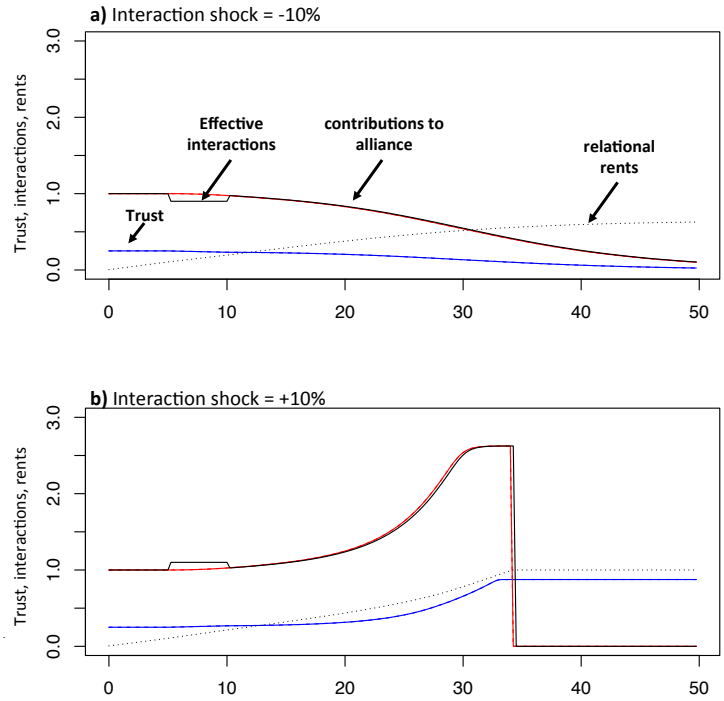

Figure 2: Trust, interactions, and relational rents with a) Interactions shock -10% and b) Interactions shock +10%

While this particular experiment nicely illustrates the fundamental tipping behavior generated by trust-contributions interactions in alliances, there are some strong assumptions of substitutable contributions and symmetry between partners underlying it. A more comprehensive set of simulations shows how the difference between success and failure depends on structural and initial conditions. First, Figure 3 shows tipping regimes of relational rent for multiple scenarios, varying initial trust and contributions each between zero and one, for both partners at the same time. The contrast, ranging from white to black, identifies relational rents achieved when the simulation is run ad infinitum. In cases the feedback loop creates a vicious cycle of trust and contribution erosion before the goals are met, rents remain below 1. Higher initial trust or initial contributions of course improve relational rents. However, Figure 2 shows a clear tipping boundary, a set of combinations of low initial trust and initial commitment separating a regime of failures (light grey area) and successes (black area) . The open white dot represents the combination of initial trust and initial desired meetings for both partners used in Figure 2 and lies on the tipping boundary. The convex shape of the boundary further highlights that it is difficult to make up for low initial contributions or trust. When either is low (compared to normal) a disproportionally high initial value of the other is necessary to make up for its deficit.

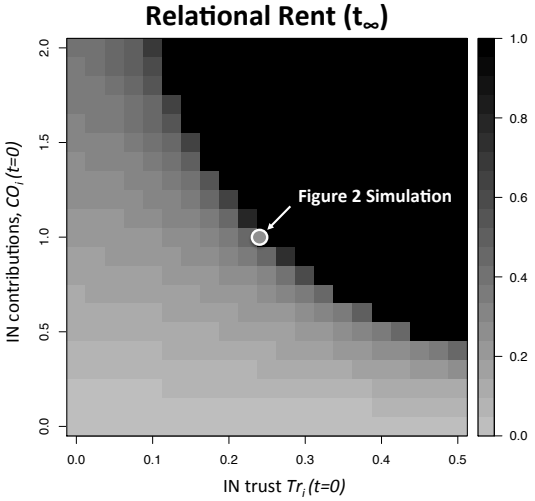

Figure 3: Tipping boundary between success and failure regimes for varying initial desired meetings and trust

In Figure 4 we explore the role of asymmetry, of initial conditions between partners, varying their initial trust independently. We examine this in combination with varying alliance complexity (varying ρ). In Figure 4a) we assume a simple alliance in which both partners' knowledge contributions are perfectly substitutable with one another ($\rho = 1$). We observe again a clear tipping boundary, with the case of Figure 2 marked here as well (with symmetric initial conditions, hence on the 45 degree line). In this case the shape of the tipping boundary is concave. In an alliance environment with high substitutability of contributions, the partners may

build up trust more easily as employees of one firm are interested in meeting and interacting with the partner firm's employees more often. This increases productivity, trust builds up faster, also for the other partner, which in turn becomes more committed and alliance goals are also reached earlier. Here, initial trust of one partner firm may be considerably lower than the partner's in order for the alliance to be nevertheless successful.

Assuming more complex alliance interactions characterized by high mutual dependence of the partners' - e.g. high-tech - knowledge in order to meet the alliance goals ($\rho = 0$), alters dynamics (Figure 4b). As long as partners contribute equally, dynamics are independent of the degree of substitutability between tasks: The 45-degree lines are identical for Figure 4a and b. Hence, the simulation of Figure 2 does not change in case of $\rho = 0$. The shape of the tipping point boundary changes however from concave to convex (Figure 4a versus 4b). For complex alliances, low trust by one partner can easily create alliance failure. Low trust leads to low contributions from one. Even though the contributions of the other partner are high, because of the high interdependencies of contributions, the effective alliance interactions are suppressed.

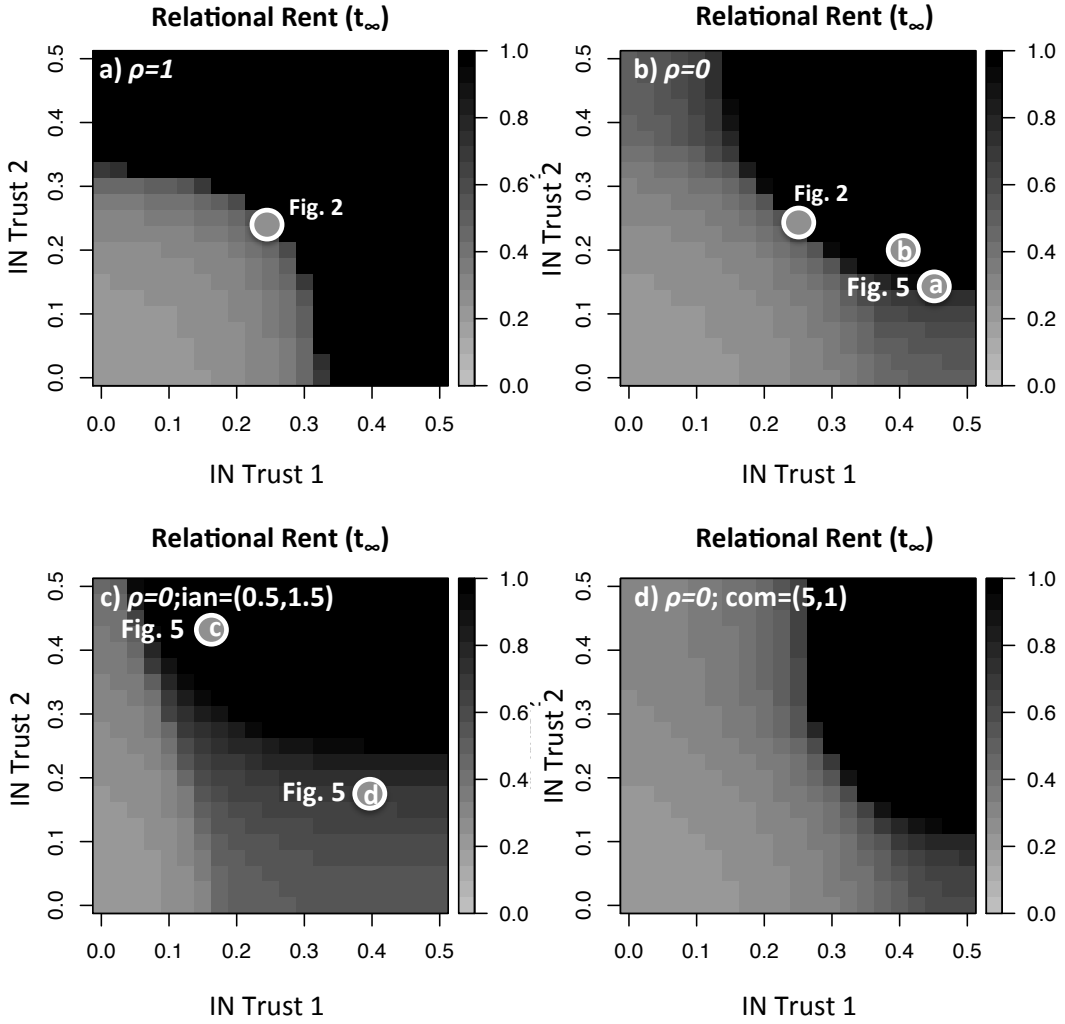

Figure 4: Tipping regimes for initial trust of both partners

Figure 5a and b, both highlighted in Figure 4b, show two illustrative cases of this situation. In

Figure 5b, Partner 2's initial trust is considerably lower than Partner 1's (P1 Initial trust = 0.45; P2 Initial trust=0.15). With Partner 1's initial trust being higher, she is interested in interacting with Partner 2. Partner 2, with low trust, is hesitant to contribute. As Partner 1 wants to meet more often, they actually begin to interact more often, though less than she desires – effective interactions are below her contributions. Nevertheless, they do meet often enough to push effective alliance interactions a little bit up until week 10. However, effective interactions then begin to decline. The downward pressure of Partner 2 to interact is stronger than the upward pressure from Partner 1. Eventually, alliance goals are met, but considerably later than in the base case above (week 49, compared to week 34 in Figure 2b). In the second illustrative case (

Figure 5b), Partner 1 has still higher initial trust (0.4) than Partner 2 (0.2). However, the asymmetry is less than in the previous situation. While the difference between the initial conditions of Figure 5a and b is marginal, in this case the commitment of Partner 2 now remains sufficiently high for interactions to keep growing, and, through that, also trust of Partner 2. With Partner 2 also committed, for both partners the positive feedback loop works in the virtuous direction and effective interactions keep increasing. The alliance goals are met early, in week 30.

Back to Figure 4, the bottom graphs show the implications between structural asymmetry between partners, still for high interdependency situations ($\rho = 0$). Figure 4c shows situations in which the normal interactions – necessary to maintain trust, *ian*, vary across partners. While normal interactions are low for Partner 1 ($ian_1 = 0.5$), they are high for Partner 2 ($ian_2 = 1.5$). These assumptions lead to a more asymmetric shape of the tipping regimes. Further, the failure regime is larger than the one in Figure 4b. In this case, with trust buildup of Partner 1 is constrained, it is difficult for the partner firms to build up the necessary interactions from both partners. With that trust also tends to be suppressed.

Figure 5c and 5d show this in further detail. Figure 5c shows a particular case in which the alliance can be more successful under this asymmetry, and the overall goals are achieved earlier: this is because of Partner 1's low normal interactions required to build up trust. Partner 1's desired interactions first decreases, but as it only takes a few interactions to build up trust, Partner 1's trust increases very fast. With that, her contributions quickly begin to align with those from Partner 2. The alliance goals are met in week 28 (instead of week 39) and trust between the partners stays high. Thus, Partner 1, while initially with low trust, successfully turns around Partner 2's early reduction in trust. Hence, partners do not necessarily have to have a similar

initial level of trust towards each other in order for making an alliance successful. However, in more cases, the relational rents are harder to meet than when partners have identical expectations about interactions.

Figure 5d shows one such case. Partner 2's has lower trust (0.2) than Partner 1 (0.4). As can be seen in Figure 5d, Partner 1's trust builds up fast(er than Partner 2's) as its Normal desired interactions are relatively low (0.5). Yet, Partner 2 needs more interactions to sustain trust than Partner 1. While the interactions productivity is first increasing, it then decreases after a further increase in Partner 1's Desired interactions is no longer possible. Partner 1's trust stays on a constant level below 1, while Partner 2's trust is depleting. Consequently, interaction productivity decreases. This alliance situation cannot be considered as successful as only about 68% of alliance goals are met.

Figure 4d, finally highlights situations when partners vary in their maximum desired interactions. This represents situations in which one of the partners is more resource constrained – for example they are limited in the number of employees that they can send into the alliance. The maximum desired interactions actually limits the time that is available for partners to engage in the alliance. In this situation, the tipping turns out to be asymmetric. Here, Partner 1 has actually more employees available than Partner 2. It is thus easier for Partner 1 to schedule more meetings, for example, than for Partner 2. It can be seen from the tipping regime that under these assumptions, a partner's (here, Partner 2's) initial trust can be lower than the partner's for the alliance to be successful.

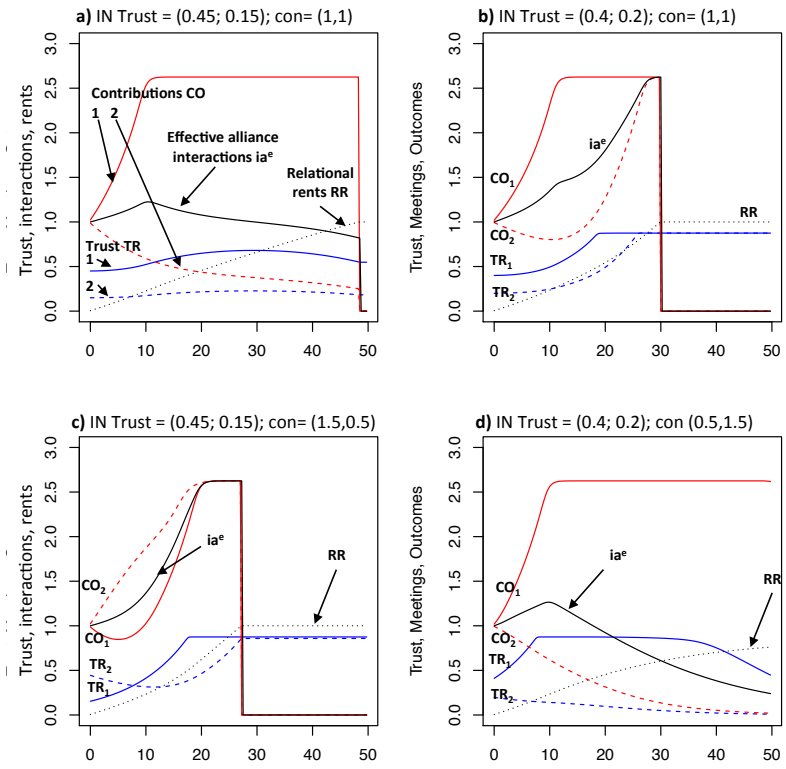

Figure 5: Over time simulations of selected success and failures

Extension: Openness in learning alliances

The analysis so far has interpreted alliance dynamics being determined by full openness of both partners. In other words, so far, we analyzed the special case in which both partners were able to decide on their allocations based on their trust in the partner firm. But their openness was assumed to be constant at 1. Openness, however, while critical for the functioning of the alliance involves large costs at the individual firm level: when knowledge spills over firms risk strengthening the alliance partner beyond the scope of the alliance. Such costs imply an important tradeoff in the benefit of openness which therefore is often managed a strategic decision. When collaborating in an alliance, the partners produce a common good – the knowledge resulting from the learning alliances is built up and accessible to the partners. However, if ones' openness is not directly or imperfectly observable to the other partner, one partner may enjoy the benefits of the collective good with contributing less than agreed to its creation – hence, it may free ride (Dyer & Nobeoka, 2000; Flam, 1990; Oxley & Sampson, 2004). More subtly, with increasing openness, there are more opportunities for the partner to outlearn a player. In the case of outlearning, one partner uses its originally well-intentioned and trusting partner and exploits its knowledge base without reciprocating, thus holding back own knowledge which would actually be required for building up the common knowledge base (Inkpen, 2000b; Inkpen & Currall, 2004; Khanna et al., 1998; Oxley & Sampson, 2004). Thus, openness may be deliberately set below 1. Formally, one can see this in the profit function for partner I, with net benefits, b_i equaling Relational Rents minus the costs of openness:

$$b_i = RR - c_i\left(OP_i\right) \tag{7}$$

with $c_i = OP_i^{\alpha}$ and, since cost increase in openness, $\alpha \geq 0$, while often $\alpha \geq 1$.

To see the strategic importance of openness consider first a simple model in which a partner sets openness prior to engaging in the partnership, based on a static expectation of the drivers of effective alliance interactions. Thus, openness and contributions, remaining constant throughout the alliance, statically determine effective alliance interactions following Equation 1-3. Figure 6 shows one firm's net benefits (as well as relational rents and costs) as a function of openness, assuming full openness and contributions from the partner. In this case, contributions, from both partners, are assumed to be equal to normal contributions and openness, from the

partner, equal to 1. Finally, for openness costs, $\alpha = 2$, reflecting the notion that high openness can lead to disproportionally high costs.[1]

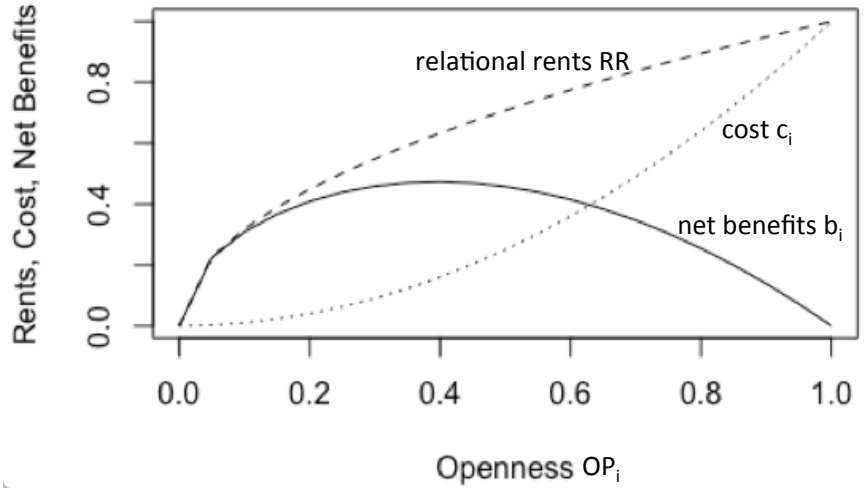

Figure 6: Alliance net benefit (solid line), relational rent (dashed line), openness costs (dotted line) as a function of openness of partner i, static model.

Relational rents exhibit diminishing returns in openness, because the limited substitutability of partner tasks. As a result, in this model, net benefits are inversely U-shaped. In this particular case, optimal openness is just below 0.4, well below 1.

While this illustration seems overly stylized, the underlying assumptions are implicit in static models of openness. Further, this setup corresponds with a situation in which ex ante partners' mental models are based on these assumptions. Ex ante actors must make some simplifying assumptions about others' behaviour. Assuming that others will not respond to openness will be justified when one's openness is not observable by a partner. Yet, while perhaps not directly observable, the effectiveness of the interactions are. For this reason, the static results form an excellent reference point to examine how trust dynamics affect such strategies. Doing this we now endogenize trust, per the above model, and openness itself step-by-step in our analysis.

Openness with endogenous trust

Now we investigate how strategic positioning towards openness changes when contributions by the partner are endogenous. The cost curve is identical to the experiment with the static model. However, instead of fixed contributions in Equation (3) we now allow contributions of the partner firm to change based on the trust dynamics (Figure 1, the positive "*Trust*" feedback, R1, and Equations 4-6). Figure 7 shows, as a reference, the net benefit when

[1] For example, the risk of critical private knowledge leaking gets much higher when more knowledge is shared (NEED REF). (Note however that none of our conclusions below depend on α being larger than 1.)

including trust dynamics (thick solid line) compared to that of the static case (Figure 6), as well as the cost curve (unchanged, dotted line). As above, we vary the value for Partner 1's openness in the following experiments and hold it constant throughout the alliance. Endogenous trust of the partner company has a market impact on the net benefit. For low openness, the relational rent stays low because the suppressed effective alliance interactions wear down trust of the partner. The partner reduces its commitments, further suppressing effective interactions. Unless openness increases to 0.52, the alliance remains trapped in the low performing state – even with Partner 1 keeping its own contributions constant, conform dynamics discussed with Figure 4 and 5.

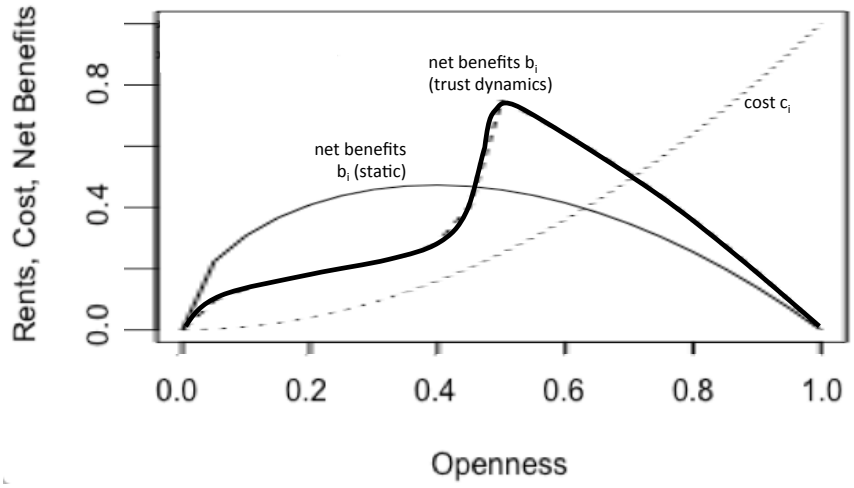

Figure 7. Alliance net benefit including trust dynamics (thick solid line) compared to that for the static case (thin solid line), and openness costs (dotted line), as a function of openness of partner i.

However, if Partner 1 sets openness above this dynamic threshold level, Partner 2 begins to increase its trust and commitments above expected levels and rents are much higher than in the static case. While eventually also here the cost of openness prohibit the benefit from to much openness, in the dynamic case the required openness is much higher. Further, because of the presence of the positive feedback loop, there is a large risk of approximating the optimal value for the static case.

Dynamics of trust and openness in alliances

So far, we have analyzed possible alliance developments from a static and a more dynamic view, in which the R1 – Trust feedback loop is active (Figure 1). We have furthermore identified that the results on alliance performance, relational rents, are drastically altered by including this feedback. In other words, depending on the dominant mental model of alliance managers on the links between trust and openness, alliances might be doomed to fail right away. In the following, we will enhance the endogenous view further by extracting additional feedback loops from openness-related interactions the literatures identifies (Figure 8). We then analyze dynamics of each loop individually and collectively.

As laid out above, the literature identifies trust between the partnering firms as a key determinant for learning alliance success. Trust contributes to the free exchange of information between committed partners (Inkpen, 1995). When members on all organizational levels work in an atmosphere of trust with their partners, they do not feel as if they need to protect themselves from opportunistic behavior. Even if an alliance contract allows free flow of knowledge and spillover between the partners – without trust, knowledge exchange would be low in accuracy, comprehensiveness, and relevance (Zand, 1972). Therefore, effective alliance interactions require both, openness of the involved people and actual contributions, i.e., resources. When people perceive progress, trust between the employees is active in the alliance increases again, leading to the closed feedback loop of "travelling trust" (Figure 8, R2, *Traveling trust*).

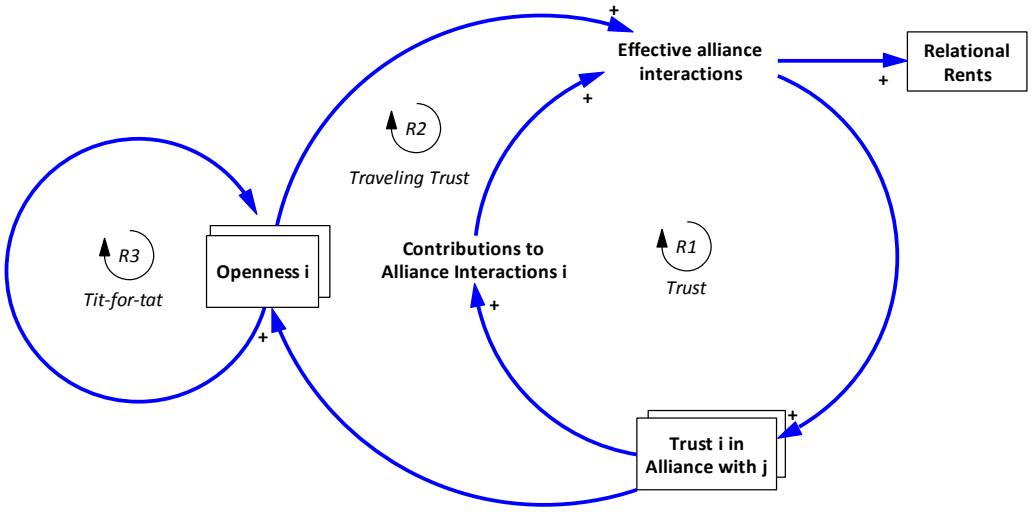

Figure 8. Full feedback structure of trust-openness dynamics: R1 Trust, R2 Traveling Trust, and R3 Tit-for-tat

Experiments in behavioral game theory demonstrate that people do behave fairly in bargaining situations (Camerer, 2003; Camerer & Thaler, 1995). Knowledge exchange and common learning in learning alliances can be interpreted as bargaining in the sense of "you may learn from me but I also learn from you"(Inkpen, 2000a: 1027). So, when one employee of a partner firm is open to her colleague from the alliance partner firm, the colleague reciprocates this openness. More generally, members of one organization who receive knowledge from a member of the partner firm pay back this favor in a following period (Das & Teng, 2002; Muthusamy & White, 2005). Consequently, when one partner firm is open to its partner, the partner tries to be similarly open to the other. This interplay results in an ever increasing reciprocal openness between the collaborating partners, following tit-for-tat until a complete openness toward each other ensues. This increasing structure is depicted in the reinforcing "tit-for-tat" feedback loop (Figure 8, R2, *Tit-for-tat*).

For the remaining analysis, in which we expand the trust dynamics to include openness dynamics e operationalize openness in the same we as we did for trust and contributions. Thus:

$$\frac{dOP_i}{dt} = g_{co}\left[f_{opop}\left(\frac{OP_j}{opn}\right) f_{trop}\left(\frac{TR_i}{opn}\right) - 1 \right] * OP_i;\ \ f_{opop}(\bullet)', f_{trop}(\bullet)' \geq 0 \qquad (8)$$

The results of the experiments of activating the three loops individually and altogether is depicted in Figure 9. For all experiments we assume the same cost curve introduced in Figure 6(dotted lines). Figure 9a replicates the results of Figure 7. In the experiment shown in Figure9b), traveling trust, we note that with increasing openness, net benefits first increase and then decrease at a steeper rate than in the static case. The peak, of 0.37 is close to that of the base case. Feedback dynamics that include openness R3 (Tit-for-Tat), as depicted in Figure 9c resembles closely the one of tit-for-tat (Figure 9b). Hence, contrasting to trust dynamics these feedbacks do not shift the optimal openness, they strengthen the peak.

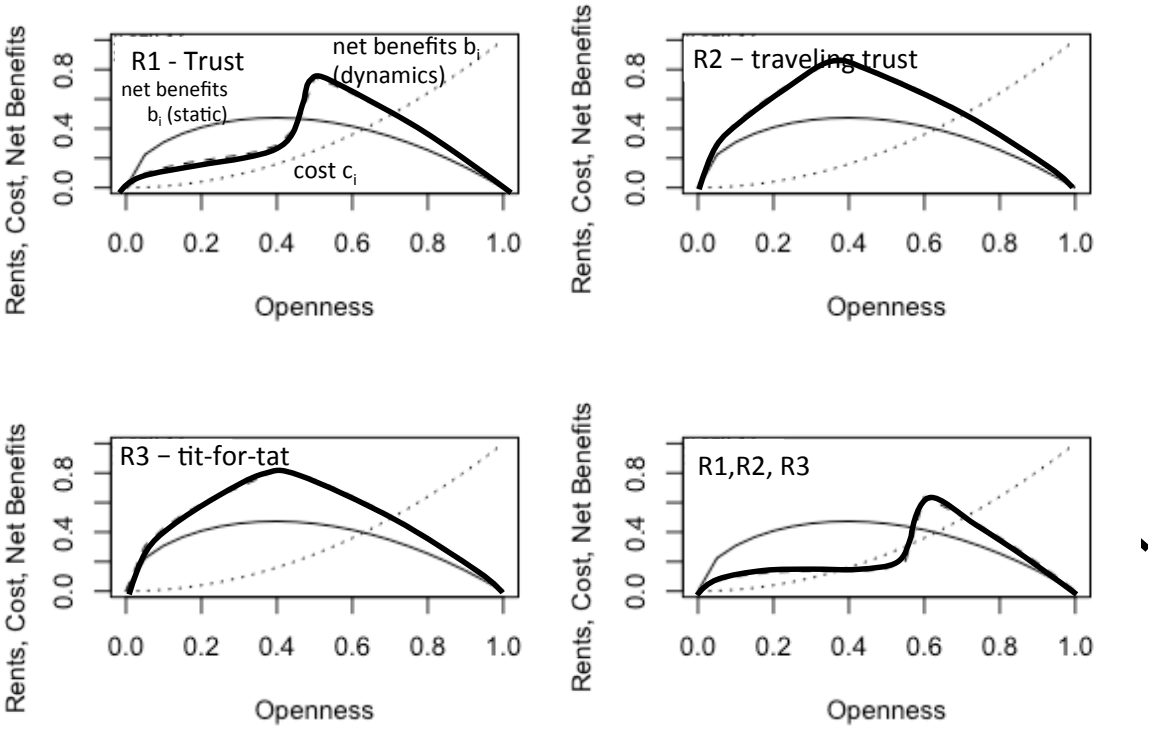

Figure 9. Alliance net benefit including dynamics (thick solid line) compared to that for the static case (thin solid line), and openness costs (dotted line), as a function of openness of partner i: a) R1 only. B) R2 only; c) R3 only; d) All loops.

Finally, when all loops are closed (see Figure 9d), the trajectory of the net benefits reinforce the basic insight from Figure 9a). Net benefits yield a maximum (Max.e=0.46), when Openness is at 0.6. Thus, the interaction of the two new loops that involve openness do shift the peak openness further to the right.

Discussion and Implications for Practice and Research

One main reason for alliance failure is low or disappearing trust. While widely discussed in the literature, the concept of trust is yet not fully understood. In this paper we use a stylized simulation model to analyze the dynamics of trust, its drivers, and its effects on relational rents of an alliance of two firms with the goal to jointly learn with each other. With this model we seek to develop a better understanding of the dynamic behavior in alliances. We thus tested different experiments in which we assumed that two firms enter an alliance to learn jointly with each other on agreed on alliance goals for about two years. Our analysis provides the two main insights.

First, if alliance managers follow a simple mental model with a static point of view in their management of an alliance, the approach just suggests a simple hillclimbing strategy. This approach suggests not being more open, as soon as net benefits rents are just about to decrease. Yet, when moving to a more dynamic point of view, and when the dynamics include endogenous trust and openness, the shape of relational rents turns out to be different. This radically alters the shape of the net benefit curve. First, the peak of openness shifts to the right – when initial openness is higher. Second, the resulting curve has a steep cliff on the left shoulder. Thus, simple hillclimbing to find the optimum is not only in efficient, it can also drive the alliance to failure once managers move openeness to the left of the cliff – a level of openness suggested as effective by a static mental model. These insights resonate with those derived by Rahmandad (2012) in the context of managing internal capabilities.

Second, we learn that including a richer feedback structure – involving openness dynamics - further accentuates those findings. In turn, openness dynamics thus imply that too little openness is swiftly dangerous as the alliance can easily runaway into a vicious cycle of trust depletion and openness detoriation. The sensitivity analysis further revealed that the cliff increases with interdependency of the tasks and asymmetries between the two alliance partners.

Third, our analysis revealed that the reinforcing loop R1 "Trust" is dominant for the alliance success. Its behavior is shaping the overall alliance behavior when all three loops are active. This means that alliance managers need to carefully consider that trust of both partners is determined by its drivers, thus the effective interactions. In other words, it is the trust that builds up because of a blend of emotional bonds between people who work in the alliance partner companies(affect-based trust (McAllister, 1995)), reciprocal responding (personal trust (Luhmann, 1979)), sharing cognitions and common ways of thinking (cognitive trust (Lane, 1998)), the ability to perform according to an agreement (competence-based trust (Nooteboom, 1996)), past exchange (process-based trust (Zucker, 1986)), and how open employees of both firms in the alliance are towards each other or how reciprocally they act (behavioral-based trust

(Inkpen & Tsang, 2005) – subsuming the bonding and communication skills in Schreiner et al.'s (Schreiner et al., 2009) concept of alliance management capability .

More generally, we infer from our analyses that alliances need to be carefully managed. When managing an alliance based on a simple statics point of view, the actual complex interplay between trust, its drivers, and its effects can easily be misinterpreted. If no precautionary approach is followed, an alliance which seems to be driven by virtuous cycles towards reaching the common goals may turn into an alliance determined by vicious cycles – from our analysis we learned that this turn can go very quickly (see Figure 5).

Furthermore, we also learn from Figure 5 that partners with asymmetric preconditions on trust can work successfully in an alliance. The partner with lower initial trust can be dragged into interaction with the higher trusting partner firm. This is especially important for alliance managers to realize when they enter an alliance – and they might perceive that the partners are somewhat asymmetric, i.e., they realize that representatives of the partner firm are hesitant while their team is highly motivated.

Yet, the analyses also reveal limitations. For example, we acknowledge that there are many different forms of alliances and many different motivations for firms to enter alliances (Child & Faulkner, 1998; Contractor & Lorange, 1988). Here, we develop just a stylized model of two firms that enter an alliance. For our experiments we assume the special case that they entered the alliance with the objective to learn with each other. Also, our model lacks empirical metrics for some of the constructs used. Finally, we focus on the feedback structures around trust. We recognize that there are many more influencing factors on alliance success which are described in the literature.

Despite these limitations, we increase clarity the constructs around trust. There is a vast literature on trust, alliances, openness, etc. We provide a first attempt for an internally consistent and closed-loop framework for better understanding the development of trust dynamics in alliances to explain success and failure of alliances. It is still a highly fruitful area for research as the interdependences between the constructs are highly interactive, which many decision makers, alliance managers, and scholars still try to understand better. Our approach allows for further iterations.

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