
Determinants of governance structure in alliances: the role of strategic, task and partner uncertainties

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Research in transaction cost economics and structural sociology has emphasized the role of opportunism and trust in the choice between equity and non-equity governance forms in alliances. This paper suggests that the uncertainty surrounding partner cooperation is not straightforwardly predictive of governance structure in alliances. Instead, task uncertainty and strategic uncertainty associated with the activities performed within alliances induce coordination and adaptation requirements that are important determinants of alliance governance, independently of partner uncertainty. Support for this view is provided based on a 12-year panel of alliances formed in the US telecommunications, entertainment and computer industries.

1. Introduction

The process by which firms choose among the variety of collaborative agreements available to them has been the object of numerous studies in strategy and organizational theory (e.g. Pisano *et al.*, 1988; Gulati, 1995a; Oxley, 1997; Das and Teng, 1998). The largest part of this research has focused on *partner uncertainty* as the primary determinant of governance choice in alliances. Drawing from transaction cost economics (Williamson, 1975, 1991) and the sociological theory of embeddedness (Granovetter, 1985), this literature proposes that different alliance governance forms offer varying degrees of control over the uncertainty surrounding partner cooperation, and that trust is a social mechanism for cooperation that substitutes for (or complements) bureaucratic or contractual mechanisms of control (for a review, Das and Teng, 1998). This view has led some to suggest that the trust accruing to alliance partners throughout their interaction history reduces the need for control, thus leading to a systematic evolution of alliance relationships from the safeguards and control of hierarchical arrangements to the trust-based flexibility of less hierarchical governance forms (Gulati, 1995a).

In contrast with its focus on partner uncertainty, this literature has devoted less attention to the analysis of how the nature of the activities performed within the alliance affects its governance structure. Drawing from classics in organizational theory (e.g. Barnard, 1938; Thompson, 1967; Galbraith, 1977), this paper aims to refocus the

study of the choice of governance structure in alliances on its functional bases, while raising questions about the relevance of partner uncertainty to this specific domain of interfirm behavior. I propose that the *task uncertainty* and *strategic uncertainty* associated with the activities typically performed within alliances (namely R&D, manufacturing, marketing, licensing and supply activities) induce coordination and adaptation requirements that are primary determinants of the choice of governance structure, *independently* of concerns surrounding partner cooperation. According to this view, the history of interaction between alliance partners may increase their likelihood of forming alliances in the future, but has little influence on the way they organize their collaboration. Support for a view of task and strategic uncertainty as the driving force behind the choice between equity and non-equity governance forms is provided with panel data on alliances formed between 1988 and 1999 among 109 large US public companies in the telecommunications, entertainment and computer industries.

2. Partner uncertainty and governance structure

2.1 Repeated ties and partner uncertainty

Granovetter (1985) pointed out that social interaction is characterized by a widespread preference for transacting with actors with whom there exists a continuing relation. Not only do continuing economic relations provide evidence about the past behavior, but they also become overlaid with social content that carries strong expectations of trust and abstention from opportunism (Kogut, 1989; Heide and Miner, 1992; Gulati, 1995a). The exchange theory literature has also documented the tendency of economic actors to engage in repeated exchanges with their prior partners (Cook and Emerson, 1978). Similarly, Carley's constructuralist theory (1991) suggests that, as the number of past interactions between social actors increases, their shared knowledge also increases, thus boosting their preference for interacting with each other. In general, repeated exchanges serve as a means for uncertainty reduction in inter-firm relations (Podolny, 1994).

Overall, there is extensive support for the notion that repeated interaction provides firms with more information about one another, therefore reducing partner uncertainty and creating more solid bases for future interaction. This implies that, as the number of past alliances between two firms increases, the knowledge these two firms have about each other also increases, and so does their preference for interacting with one another. What is far less clear is whether, and how, the information and social bond stemming from repeated interaction among organizations affects the governance of their alliance relationships.

2.2 Equity and control

A large part of research on the choice of governance form in alliances has been based on the distinction between equity and non-equity arrangements (Pisano, 1989; Osborn

and Baughn, 1990; Oxley, 1997). Equity alliances involve, by definition, common ownership, and are typically organized as joint ventures. In the market-hierarchy continuum of organizational forms, equity joint ventures most closely replicate the characteristics normally associated with hierarchies, as they entail the creation of a separate administrative structure with formal coordination and control mechanisms. Non-equity alliances, on the contrary, are contractual agreements that lack shared ownership or dedicated administrative structures. For this reason, equity arrangements are seen as governance forms fundamentally different from non-equity alliances, which are more akin arm's length market exchanges (Contractor and Lorange, 1988).

Research concerning the choice between equity and non-equity contracts has traditionally focused on the level of control typical of different governance forms (Das and Teng, 1998). Part of this literature assumes that, because equity alliances provide more control over partner behavior than non-equity alliances, non-equity arrangements require a higher level of trust than equity arrangements to effectively manage the uncertainty surrounding the alliance partner's behavior. According to this view, through the familiarity developed in past alliances, partners build enough confidence in each other to give up the hierarchical control offered by equity forms of governance, in favor of the trust-based flexibility of non-equity alliances (Gulati, 1995a).

However, the notion that, in the absence of trust, equity arrangements protect collaborators from undesirable partner behavior more effectively than non-equity arrangements is questionable. In fact, equity and non-equity arrangements offer different sets of advantages and disadvantages in controlling partner behavior, with neither governance form dominating the other in this respect. Specifically, equity alliances are believed to provide partners with more control by creating a 'mutual hostage' situation that helps align the interests of all partners, since partners' concern for their investment reduces the probability that they will behave opportunistically (Williamson, 1975; Pisano *et al.*, 1988). However, it can be argued that the 'mutual hostage' condition protects partners from each other while exposing them to a different type of risk. For instance, firms competing in the same markets may attempt to use an alliance to gain as much as possible from their partners while sharing as little as possible of their knowledge and resources (Doz *et al.*, 1989; Hamel, 1991). In such a context, by facilitating the unintended transfer of tacit knowledge across tightly connected organizations (Hennart, 1988), joint ventures can provide a partner with greater opportunities for 'free-riding' than non-equity alliances. In general, because they entail the establishment of an *ad hoc* organizational entity, equity alliances require a higher level of alliance-specific investment than non-equity alliances (Das and Teng, 1998), and thus a higher degree of mutual dependence and connectedness between partners (Osborn and Baughn, 1990). Therefore, in spite of the commitment they induce (and because of it), equity investments increase the difficulty and cost of exit, thus intensifying the vulnerability to undesirable partner behavior (Bensaou and Anderson, 1999). For these reasons, equity alliances may require a higher level of confidence in a partner than non-equity arrangements (Das and Teng, 1998).

Equity alliances are also believed to provide partners with more control than non-equity alliances by virtue of the establishment of an administrative hierarchy that allows partners to exercise their residual rights of control (Pisano *et al.*, 1988). This argument, however, is debatable for two reasons. First, neoclassical contracts are not indefinitely elastic and provide weak protection against significant deviations from expected behavior (Williamson, 1991). As the partners' autonomous status provides continuous incentives to defect, the investment of non-recoverable resources in equity alliances exposes partners to potentially more serious consequences of opportunistic behavior than a contractual agreement with low barriers to exit. Second, the establishment of a full range of inter-firm coordinating mechanisms for communication, joint decision making, and negotiation required by equity alliances (Grandori and Soda, 1995) says nothing of the distribution of control rights among alliance partners. Equity ownership is equated to control under the assumption that more equity shares give a partner more voting power (Blodgett, 1991). This assumption, however, has been challenged in research suggesting that control is far from a necessary consequence of equity alliances, and ownership plays only a limited role in providing control in joint ventures (Geringer and Hebert, 1989). Mjoen and Tallman (1997), for instance, showed that the relative degree of control of parents in a joint venture is determined by a bargaining process based on the importance of the individual resources they each contribute, implying that governance is based on resource-specific control, rather than ownership level.

The assumption that increased control over the behavior of alliance partners is a necessary consequence of equity deals is therefore problematic, since compelling arguments can be proposed for a positive *and* a negative relationship between partner uncertainty and the choice of equity governance forms. If partner uncertainty does not have clear effects on the choice of governance structure in alliances, then what accounts for the selection of equity or non-equity collaborative forms? I propose that the choice of governance structure is driven by a different source of uncertainty, that is, the uncertainty stemming from the functional goals of the alliance, rather than by the level of trust and control surrounding the behavior of a partner. According to this view, equity and non-equity governance structures provide distinct advantages depending on the nature of the activities the alliance was created to perform—namely, R&D, manufacturing, marketing, licensing and supply activities.

3. Task uncertainty, strategic uncertainty and governance structure

3.1 Task uncertainty

The notion that organizational design is variously contingent on the task at hand permeates organizational theory. Barnard's (1938) theory of cooperation is founded on the notion that organizational hierarchies reduce the uncertainty of performing complex and interdependent tasks to achieve coordination and, ultimately, cooperation.

Thompson (1967) offered a detailed theoretical treatment of the relationship between the nature of the task and the structure of the organization. In Thompson's work, task interdependence captures the extent to which the elements of the work being performed are interrelated so that changes in the state of one element have repercussions on the state of others. The degree of task interdependence is crucial to the understanding of organizations as it can be used to predict a variety of their structural features. Galbraith's (1977) contingency theory also highlights the role of organizational design to manage the information-processing demands of task environments characterized by varying degree of uncertainty and complexity. Through a variety of structural interventions—ranging from rules and programs, to departmentalization, hierarchy and slack resources—organizations are able to respond to the information-processing demands of tasks characterized by varying degrees of diversity, uncertainty and interdependence. These theoretical contributions have received ample empirical support in research on organizational design at both the intra-organizational (e.g. Van de Ven *et al.*, 1976; Tushman, 1979) and the inter-organizational level of analysis (e.g. Van de Ven *et al.*, 1979).

In spite of the long-standing tradition in organization theory emphasizing the link between task and structure both at the intra- and inter-organizational levels of analysis, most of the current empirical literature on the choice of governance form in alliances is primarily concerned with partner uncertainty. This tendency runs counter to research highlighting the diversity of functional goals typical of different forms of alliance governance structures (Hagedoorn, 1993; Das and Teng, 1996; Gulati and Singh, 1998). Indeed, equity alliances differ from non-equity agreements in that they tend to produce rather complex, firm-like organizations, which pursue a multitude of goals (Hagedoorn, 1993; Hagedoorn and Sadowski, 1999). Even when the characteristics of specific alliance activities have been investigated (Pisano *et al.*, 1988), the reliance on a multitude of *ad hoc* explanatory mechanisms has hindered the elaboration of a parsimonious and generalizable account of the relationship between alliance content and governance structure.

The possibility of systematic differences in the work performed within alliances, and the research relating work characteristics to structural choices within and between organizations, require that the nature of the task be brought back in the analysis of alliance governance form. An important study by Gulati and Singh (1998) moved decidedly in this direction by addressing directly the relationship between coordination requirements and choice of governance structure in alliances. The results of this work provide support for the critical role of task interdependence in how alliances are organized. Using Thompson's (1967) seminal distinction between pooled, sequential and reciprocal interdependence, the authors showed a positive relationship between the type of interdependence intrinsic in the task performed within the alliance and the likelihood of adopting equity forms of governance of the relationship.

Task interdependence is, together with task complexity, a primary contributor to *task uncertainty*, a focal dimension along which organizational tasks can be analyzed

(Scott, 1998). Task uncertainty can be defined as the extent to which it is possible to predict in advance the behavior of the elements that compose the task. Task interdependence contributes to task uncertainty by increasing coordination requirements. Task complexity (defined as the number of elements that compose the task, and the number of relationships among them) contributes to task uncertainty by increasing information-processing requirements. The coordination and information-processing requirements induced by task uncertainty impact the structural design of organizations by increasing the need for adaptation, communication and integration mechanisms (March and Simon, 1958; Simon, 1962; Thompson, 1967; Galbraith, 1977). In an investigation of buyer–supplier relations, Bensaou and Anderson (1999) specifically showed that task interdependence and task complexity are positively associated with partners' decision to make relationship-specific investments in coordination and adaptation mechanisms. By virtue of the establishment of an *ad hoc* administrative hierarchy with the full range of formal systems for communication, joint decision-making and negotiation, equity alliances provide partners with the administrative tools necessary to manage demanding information-processing and coordination requirements. This suggests that higher levels of task uncertainty are likely to be associated with equity governance forms.

The relationship between task uncertainty and governance structure that I propose differs from the one put forward in transaction cost economics (TCE). In TCE, coordinated realignments induced by changing circumstances create the risk of opportunistic behavior, and thus obstacles to *cooperation*. I propose that task uncertainty creates not only obstacles to cooperation, but also obstacles to *coordination*. These obstacles exist independently of partner uncertainty, even when alliance partners are fully cooperating with one another and pose no risk of opportunistic behavior.

3.2 *Strategic uncertainty*

The partner and the task, however, do not exhaust the sources of uncertainty to which alliances are subject. Even in the presence of full partner cooperation and effective execution of the alliance task, additional uncertainty stems from the alliance partners' strategic positioning within chosen product/service/technology markets. This *strategic uncertainty* concerns the market's demand, supply and value of the products, services or technologies developed within the alliance. For instance, two alliance partners may effectively develop and bring to market a new technology, only to find that competitors have introduced radical technological changes that make the alliance partners' offering obsolete. Strategic uncertainty underlies the constitution of alliances for risk-sharing purposes (Badaracco, 1991). When the uncertainty associated with given strategic choices is too high to be sustained by a single firm, strategic alliances provide an attractive alternative, since they limit the investment demanded of each partner, and the risk associated with it (Das and Teng, 1996). In the context of the choice between joint ventures and acquisitions, Kogut (1991) showed that 'due to its benefits of sharing risk and of reducing overall investment costs, joint ventures serve as an attractive

mechanism to invest in an option to expand in risky markets.' By virtue of their reversibility—contrasted with the finality of acquisitions—joint ventures provide firms with an opportunity to stake an exploratory position in a given market, product or technology, while not fully committing to it. In the continuum of finality of interfirm relationships, non-equity alliances present lower barriers to exit, and are less difficult to dissolve, than joint ventures (Das and Teng, 1998). As such, non-equity agreements provide firms with flexible channels to explore uncertain strategic environments that entail even lower levels of non-recoverable investment and commitment than equity alliances. For this reason, non-equity alliances may be preferred to equity arrangements whenever strategic uncertainty is high.

3.3 *Joint effects of task and strategic uncertainties*

While the constructs of task and strategic uncertainty can be treated as distinct theoretical dimensions of alliance functional content, what we observe empirically are combinations of varying levels of task and strategic uncertainty that characterize alliance agreements depending on the activities encompassed by them. Most commonly organized through alliances are licensing, supply, manufacturing, R&D and marketing activities (Pisano *et al.*, 1988). I argue that, because of the varying combination of task and strategic uncertainty intrinsic in each of these activities, licensing, supply, manufacturing, R&D and marketing agreements have different propensities to be organized with equity or non-equity forms of governance.

Licensing and supply agreements are associated with low levels of both task uncertainty and strategic uncertainty. As for task uncertainty, because they involve the unilateral transfer of resources from one organization to another, licensing or supply alliances are unlikely to imply either higher forms of reciprocal interdependence that require ongoing coordination (Thompson, 1967), or high levels of task complexity that increase information-processing requirements (Galbraith, 1977). Depending on the characteristic of the product or component provided through the collaboration, however, supply agreements can require varying degrees of customization and engineering complexity, thus potentially entailing moderate levels of task uncertainty (Bensaou and Anderson, 1999). As for strategic uncertainty, these arrangements entail flows of resources (e.g. technology or products) whose function and value for the receiving firm is specified *a priori*. This does not exclude the possibility that, in the course of the exchange, new and unexpected uses of these resources may be found. However, when the alliance relationship is formed, partners share detailed knowledge concerning the value of the resource exchanged. This straightforward assessment contrasts sharply, for instance, with the intrinsically unpredictable and tacit nature of R&D activities (Balakrishnan and Koza, 1993).

Low levels of strategic uncertainty do not impose constraints on the choice between equity and non-equity arrangements. In such cases, the choice of governance form will be driven by the nature of the task being executed. When low levels of task interdependence and complexity minimize coordination and information-processing

requirements, the constitution of an *ad hoc* organizational hierarchy is unnecessarily burdensome, as it requires a level of investment costs which is not commensurate with what the task at hand requires. On the whole, the coexistence of relatively low levels of both task and strategic uncertainty suggests that licensing and supply collaborations may be more likely to be organized with non-equity arrangements.

- H1 *The presence of a licensing component in the alliance is negatively related to the choice of equity forms of governance.*
- H2 *The presence of a supply component in the alliance is negatively related to the choice of equity forms of governance.*

Manufacturing alliances entail moderate to high levels of task interdependence, and low to moderate levels of strategic uncertainty. As for task uncertainty, because they involve the simultaneous exchange of inputs and outputs among partners, manufacturing alliances tend to be associated with higher forms of reciprocal interdependence and complexity (Thompson, 1967). As for strategic uncertainty, given the large investment in physical capital they entail, decisions to co-manufacture intermediate or finished products are generally taken when the uncertainty concerning market or technological viability has largely been dispelled. The tendency to organize manufacturing collaborations with joint ventures, rather than non-equity contractual agreements was indeed empirically supported by Pisano *et al.* (1988) in a study of the telecommunications industry. The combined effect of moderate to high levels of task interdependence, and low to moderate levels of strategic uncertainty, suggests therefore that manufacturing collaborations may be more likely to be associated with equity than with non-equity governance forms.

- H3 *The presence of a manufacturing component in the alliance is positively related to the choice of equity forms of governance.*

The presence of an R&D component presents yet a different scenario, as it is associated with high levels of both task and strategic uncertainties (Pisano, 1990). As for task uncertainty, because of the interdependence and complexity of the task performed, R&D alliances increase the information-processing and coordination requirements between alliance partners (Pisano, 1990). However, R&D alliances are also characterized by high levels of strategic uncertainty, as the market's response to yet-to-be-developed innovations is difficult to predict, thus suggesting the possibility that non-equity arrangements may be preferable in governing R&D alliances. Overall, as stated by Teece (1992: 17), 'there is no arena in which uncertainty is higher and the need to co-ordinate greater than in the development and commercialization of new technology'. Because task and strategic uncertainty have opposite effects on the appropriateness of equity forms of governance, however, I suggest that the sheer existence of an R&D component is not a sufficient basis for predictions concerning the choice of equity governance form. The choice of governance structure in these cases

will depend on the idiosyncratic levels of task and strategic uncertainty associated with the specific technologies and markets encompassed by a given R&D collaboration. This implies that, depending on the sample, R&D alliances can be found to be associated with either higher or lower probabilities of equity arrangements. This is, in fact, the case, with empirical studies having documented both a negative (Pisano *et al.*, 1988) and a positive association between R&D activities and the formation of equity agreements (Pisano, 1989; Gulati, 1995a). We can shed light on these mixed findings through the very recognition that, lacking fine-grained information about the content of individual alliances, the execution of R&D activities may not be, in and of itself, a sufficient basis for the prediction of the choice of governance structure. For this reason, I formulate no prediction concerning the relationship between R&D activities and the choice of equity.

A similar scenario characterizes marketing alliances. Marketing agreements are associated with varying levels of task uncertainty, and low to moderate levels of strategic uncertainty. As for task uncertainty, the activities encompassed by marketing agreements can be as simple and limited in scope as joint promotional efforts or the unilateral transfer of marketing rights, and as complex and interdependent as the joint distribution and customer support of complementary products and services. As for strategic uncertainty, because they involve the promotion and distribution of existing products and services whose characteristics are known, marketing agreements do not expose partners to the great uncertainty associated with new product development. However, the market value of the products and services being jointly distributed or promoted may nonetheless be uncertain, potentially raising strategic uncertainty to moderate levels. Because of the varying levels of task and strategic uncertainty, I suggest that the relationship between the presence of a marketing component and the choice of equity governance form may not be unidirectional. Indeed, this conclusion was supported empirically by Pisano *et al.* (1988), who did not find any systematic tendencies for distribution/marketing collaborations to be organized with equity or non-equity forms of governance.

3.4 *Alternative explanations*

Moderating role of partner uncertainty. Williamson (1991) bases the distinction between markets, hybrid forms and hierarchies on, among other factors, the capacity to manage uncertainty through coordinated realignments between transaction partners, and the capacity to manage uncertainty through autonomy from changes in supply, demand and value of a commodity. Similarly to the predictions put forth in this paper, TCE hypothesizes that the need for coordinated realignments is associated with more hierarchical forms of governance, and the need for autonomy from changed market conditions is associated with less hierarchical governance structures. However, contrary to the mechanisms I propose for the effect of task and strategic uncertainties on the choice of governance structure, TCE posits that the relationship between uncertainty and governance form is *moderated* by asset specificity, i.e. by the possibility

that an opportunistic alliance partner may take advantage of unforeseen changes in task or market conditions. Without the potential for opportunism induced by asset specificity, TCE hypothesizes that task and strategic uncertainties will *not* have consequences for the choice of governance form (Williamson, 1991).

When task and strategic uncertainties do affect the choice of governance form, therefore, TCE presupposes that asset specificity is present in the alliance relationship. In this case, TCE and sociological theory predict that the effect of task and strategic uncertainties on governance structure is moderated by partner uncertainty. That is, if the appropriation concerns induced by asset specificity are the mechanism through which task and strategic uncertainties impact the choice between equity or non-equity governance forms, this effect should be stronger when there is great uncertainty concerning partner cooperation, and weaker when trust exists between alliance partners. To take this possibility into account, I controlled for the interaction between alliance activities (namely R&D, manufacturing, marketing, licensing and supply components) and partners' past alliances, where alliance activities measure task and strategic uncertainty, and past alliances measure partner uncertainty. Lack of evidence for a moderating effect of partner uncertainty would suggest that task and strategic uncertainties have a direct impact on the choice of governance structure, independent of the level of partner uncertainty and asset specificity in the alliance.

Firm characteristics. Firm attributes, such as size, age and performance, have been investigated by some scholars as potential determinants of alliance formation (e.g. Burgers *et al.*, 1989; Barley *et al.*, 1992; Kogut *et al.*, 1992; Davis and Stout, 1992; Koput *et al.*, 1997; Baum *et al.*, 2000). This research suggests that healthy, wealthy firms are preferred alliance partners. Moreover, to the extent that the constitution of an equity alliance absorbs more resources than simpler contractual alliances, firm size and performance may influence the ability, if not the willingness, to engage in equity forms of governance. For this reason, in the present study I controlled for the economic performance and size of the firms involved in a given alliance.

Finally, a firm's propensity to enter alliances was also controlled for. Although this study aimed to explain the choice between equity and non-equity governance structures *given* the decision to form an alliance, firms that tend to use market or hierarchical alternatives may display systematically different preferences for equity or non-equity arrangements whenever they do choose to form an alliance. For this reason, I controlled for the propensity to use equity and non-equity collaborative agreements as an inter-organizational strategy, as represented by the total number of, respectively, equity and non-equity alliances formed by a firm over time. The potential selection bias concerning the use of alliances as an interfirm strategy could also be addressed by first estimating the probability of a firm forming alliances, and then using that probability as a predictor of governance choice. In the context of this study, a direct correction of this selection bias through controls that represent the number of alliances formed by each firm in the sample is preferable for two reasons. First, the use of data on actual alliance behavior is preferable to the use of an estimated parameter for this behavior. Second,

because alliance observations are not independent, such as estimation would require the use of fixed-effects models that cannot estimate the parameter for firms that have not formed any alliances, thus substituting one kind of estimation bias with another one. For the sake of completeness of analysis, I performed this selection bias correction nonetheless, and obtained results in no way different from the ones reported here.

Industry characteristics. The propensity to engage in equity rather than in non-equity alliances may manifest itself not only at the firm level, but also at the industry level. This propensity may be an artifact of diversity in the content of alliances in different industries, but also of other industry-level institutional or competitive forces that are not captured by the content of the alliance. For instance, appropriation hazards may vary across industries depending on the strength of the appropriability regime, which is in turn a function of the value of first-mover advantages, as well as firms' ability to preserve the secrecy of innovations (Teece, 1986). For this reason, I controlled for the percentage of equity alliances formed in the industries where the firms involved in the deal operated. The incidence of equity deals, however, may not capture all the ways in which alliance formation differs across industries. For instance, the level of diversification of an alliance partner, and its ability to apply the knowledge stemming from the alliance to different markets, may impact partner choice, but not the choice of governance form. Consequently, controls for all the industries in which firms in a dyad belonged at any point in time were also introduced. Moreover, depending on the industry, the functional goals of the alliance may be associated with varying levels of task and strategic uncertainty. To account for this potential variability, I performed a complete set of two-way interaction between the industry in which partners operate and the type of activities performed within the alliance.

The frequency of the transaction also figures prominently, together with asset specificity, in TCE accounts of the choice of governance form. As frequency and asset specificity increase, TCE predicts that alliance partners will chose more hierarchical forms of governance. Following Burt (1983), I captured these transaction characteristics with the patterns of economic exchanges between all industries in which the alliance partners operate—as emerging from an input-output representation of the economy—weighted by industry concentration.

4. Methods

4.1 Sample and Data

The sample includes a total of 109 US firms. Inclusion in the data set was based on industry membership and firm size. Four-digit *Standard Industrial Classification* (SIC) codes were used to identify 28 industries within the broadly defined telecommunication, computer and information technology, and entertainment industrial groups. Table 1 provides a complete list of the sampled industries. The choice of industries was determined by a concern for external validity and statistical conclusion validity. The tendency to investigate alliance formation in the context of one or, at best, a couple of

Table 1 Means and standard deviations of variables

Variable	Mean	SD	Min.	Max.
Alliance type	0.27	0.44	0	1
Past alliances	2.24	3.60	0	23
Past non-equity alliances	1.71	2.96	0	18
Past equity alliances	0.53	1.04	0	7
Licensing alliance	0.16	0.37	0	1
Manufacturing alliance	0.10	0.30	0	1
Marketing alliance	0.37	0.48	0	1
R&D alliance	0.49	0.50	0	1
Supply alliance	0.08	0.27	0	1
Licensing \times past alliances	0.04	1.48	-2.24	15.76
Manufacturing \times past alliances	-0.05	1.07	-2.24	15.76
Marketing \times past alliances	-0.08	2.11	-2.24	15.76
R&D \times past alliances	0.17	2.72	-2.24	20.76
Supply \times past alliances	-0.05	0.94	-2.24	15.76
ROA	2.16	5.25	-44.44	27.07
Sales	17 320.39	16 077.34	0	75 774.5
Non-equity alliance history	180.75	170.53	0	937
Equity alliance history	17.44	15.49	0	89
Egonetwork size	6.47	6.24	0	35.5
Egonetwork density	51.64	59.53	0	332
Percentage of equity alliances	0.14	0.10	0.07	1
Transaction characteristics	0.05	0.07	0	0.5779
Newspapers	0.03	0.17	0	1
Periodicals	0.06	0.24	0	1
Book publishing	0.05	0.21	0	1
Miscellaneous publishing	0.04	0.19	0	1
Electronic computers	0.57	0.50	0	1
Computer storage devices	0.27	0.44	0	1
Computer terminals	0.27	0.44	0	1
Computer peripheral equipment, nec	0.59	0.49	0	1
Telephone and telegraph apparatus	0.23	0.42	0	1
Radio and TV communications equipment	0.10	0.31	0	1
Communications equipment, nec	0.18	0.38	0	1
Semiconductors and related devices	0.33	0.47	0	1
Radiotelephone communications	0.06	0.24	0	1
Telephone communications, except radio	0.13	0.33	0	1
Telegraph and other communications	0.12	0.33	0	1
Radio broadcasting stations	0.06	0.24	0	1
Television broadcasting stations	0.08	0.28	0	1
Cable and other pay TV services	0.04	0.19	0	1
Communications services, nec	0.13	0.33	0	1
Computer programming services	0.21	0.41	0	1
Prepackaged software	0.55	0.50	0	1
Computer integrated systems design	0.22	0.41	0	1
Data processing and preparation	0.14	0.34	0	1
Information retrieval services	0.17	0.38	0	1
Computer maintenance and repair	0.12	0.32	0	1
Computer related service, nec	0.32	0.47	0	1
Motion picture and video production	0.03	0.18	0	1
Services allied to motion pictures	0.02	0.13	0	1

industries (e.g. Silverman and Baum, 2002; Koput *et al.*, 1997; Gulati, 1995a,b) is detrimental to the generalizability of much previous research. One of my objectives was to enhance the external validity of the present study by encompassing both service and manufacturing industries. Moreover, since technological dynamics have been clearly identified as one of the main forces behind alliance formation (e.g. Hamel, 1991; Hagedoorn, 1993; Mowery *et al.*, 1996) and alliance structure (Pisano *et al.*, 1988; Pisano, 1989), I also wanted to encompass industries characterized by both high (e.g. telecommunication and information technology) and low to moderate (e.g. publishing and motion pictures) rates of technological change.

As for the selection of a sample of firms from these industries, all companies operating in any of the specified industries and also appearing in the *Standard and Poor's 500* in any given year between 1988 and 1999 were included in the sample. The focus on large firms has both theoretical and methodological motivations. From a theoretical viewpoint, while the patterns of interaction amongst large firms are just a part of all interactions within an organizational field, the interactive behavior of elite firms has been shown to have a determining impact in shaping the inter-organizational network (Koput *et al.*, 1997). From a methodological viewpoint, focusing on large, publicly traded US firms allows one to control for firm size and performance with the kind of complete, reliable data that are virtually unattainable when dealing with private and international firms.

For each firm in the sample, the *Securities Data Corporation (SDC)* database on alliances was searched across the 1988–1999 period. The search produced 719 strategic alliances that were formed among the 109 firms in the sample in the 12-year period we considered. SDC's alliance data set classifies alliances according to a variety of deal attributes related to the content and contractual form of the alliance. Data on all the sub-industries, defined at a four-digit SIC level, in which a company operated in each year between 1988 and 1999 were gathered through multiple sources: *Compact Disclosure*, *Ward's Industry Directory* and the *Directory of Corporate Affiliations*. Data on the patterns of transaction between and within the 28 sectors included in the study were obtained from the 1992 input/output accounts for the US economy developed by the *Bureau of Economic Analysis*. *COMPUSTAT* was the source of accounting measures of firm performance for the years 1988–1999.

4.2 *Dependent and independent variables*

Governance form. I constructed the variable *alliance type* as a dummy, where '1' indicated that the alliance of concern was an equity joint venture, and '0' that the alliance was a non-equity contractual agreement. Minority equity positions have at times been added to joint ventures to define the 'equity' category, or treated as a third typology of alliance governance that occupies the middle ground between joint ventures and contractual relationships (Killing, 1988; Gulati and Singh, 1998). The lack of consistency in the way minority equity arrangements are treated in the literature, however, reveals some difficulty in clearly identifying the distinguishing features of

these governance forms. For this reason, I adopted the two-way taxonomy that excludes minority equity positions entirely and *defines equity alliances as joint ventures only*. For the sake of completeness, however, I performed additional statistical analyses using a measure of governance form according to which equity alliances include minority stakes, as well as joint ventures. These analyses produced results that were virtually identical to those obtained by excluding minority stakes from the measures.

Task uncertainty and strategic uncertainty. Five dummy variables were constructed to denote whether a given alliance included, respectively, licensing, manufacturing, marketing, R&D or supply activities. The five dummies represent types of activities that can be performed within an alliance. These activities are not mutually exclusive, but rather can coexist within a given partnership. Based on the argument that different alliance components are systematically associated with different levels of task uncertainty and strategic uncertainties, this measurement strategy captures holistically the combined effect of both task uncertainty and strategic uncertainty.

Interaction history. For each dyad-year ijt , the variable *past alliances* was measured as the sum of all alliances, including both equity and non-equity deals, formed between firms i and j between 1988 and $t - 1$. The variables *past non-equity alliances* and *past equity alliances* were constructed subtracting, respectively, equity and non-equity deals from the variable *past alliances*.

4.3 Control variables

Moderating role of partner uncertainty. In order to account for the possibility that the effect of task and strategic uncertainty may be moderated by partner uncertainty, I constructed a complete set of two-way interactions between the five dummy variables for alliance activity, and the three measures of interaction history, *past alliances*, *past non-equity alliances* and *past equity alliances*.

Firm characteristics. For each dyad-year ijt , I controlled for the economic performance of the firm with the average of i 's and j 's weighted ROA at time t . Firm size was controlled for with the average of i 's and j 's sales at time t . I also utilized alternative controls for performance and size based on the minimum and maximum of, respectively i 's and j 's weighted ROA and sales, without obtaining noticeably different results. Hence, only analyses based on the average ROA and sales measures will be presented. Second, I measured firms' propensity to engage in equity or non-equity alliances with, respectively, the total number of equity and non-equity alliances formed by i and j between 1988 and $t - 1$.

Industry characteristics. For each dyad-year ijt , I introduced a measure for the average percentage of equity deals across the industries to which i and j belonged at time t . Dummy variables for each of the 28 industries in our sample were also constructed. For each dyad-year ijt , the dummy variable for a given industry had value '1' if either i or j operated in that industry at time t . These industry effects on the choice of governance structure, however, need not be direct. Moderating effects are also quite possible, as the

levels of task and strategic uncertainty of different alliance activities may vary idiosyncratically between industries. For instance, licensing in mature industries with well-enforced patents may present particularly low levels of strategic uncertainty. This variability was controlled for with a complete set of two-way interactions between industry dummies and dummies for alliance content. Finally, for all the industries in which the alliance operated at the time of alliance formation, industry-level transaction frequency and asset specificity (i.e. small-numbers bargaining) was controlled for with a variation of the measure devised by Burt (1983). This measure (*transaction characteristics*) reflects two components: (i) the importance of the resources provided by one industry to another, as emerging from the 1992 input/output accounts for the US economy developed by the *Bureau of Economic Analysis*; and (ii) the availability of alternative buyers of those resources, as of the 1992 concentration ratios by the eight largest firms of the *Census Bureau*.

4.4 Model estimation

This study investigates the determinants of the likelihood that two firms will form an alliance of a given kind in a given year. The unit of measurement is, therefore, the dyad-year. Since our research question focuses specifically on the evolution of the relationship between two firms, it cannot be thoroughly addressed without accounting for *unobserved heterogeneity*, i.e. a dyad's idiosyncratic and permanent preferences for forming a certain kind of alliance that are not captured by the independent variables. The issue of unobserved heterogeneity can be addressed in two ways. The first regards the simple exclusion from the analysis of dyads that have clearly demonstrated no propensity whatsoever to experience the event of interest. In the present study, we structured the alliance data in a panel, with the year as the time unit and the panel including only dyads that had formed at least one alliance during the observed time-period. Such a restriction appropriately defined the risk-set to include only dyads that are likely to form an alliance, a process, as noted by Gulati and Gargiulo (1999: 1485), 'analogous to removing men from pregnancy studies'. The residual unobserved heterogeneity among dyads that cannot be excluded *a priori* is typically addressed with either random-effects or fixed-effects panel models. The primary issue concerning the random-effects model is its reliance on the assumption that the random error term is not correlated with any of the regressors. This assumption often proves unrealistic. It did so in the present study too, as demonstrated by a Hausman test performed on a fully specified random-effects panel model ($\chi^2_{42} = 88.08$; $P < 0.0001$). The correlation between the error term and the regressors results in bias in the coefficients estimated from random effects models. For this reason, I tested the relationship between alliance history and choice of governance structure with fixed-effects panel logistic regression models of the following form:

$$p_{ij}(t) = \Phi [a + bx_{ij}(t-1) + cy_{ij}(t) + d_{ij}]$$

where $p_{ij}(t)$ is the probability of a deal announced at time t between i and j being an equity alliance, $bx_{ij}(t-1) + cy_{ij}(t)$ are time-varying sets of covariates characterizing i and j , d_{ij} is a vector of $(N-1)$ dummy variables representing fixed effects for the N cross-sectional units, and Φ is the cumulative distribution function. Unlike random-effects models, fixed-effects models include only dyads that formed both equity and non-equity deals during the time period considered. From a theoretical viewpoint, such an analysis is appropriate to the study of transitions from one type of governance form to another induced by repeated interaction. According to this logic, dyads that have formed both equity and non-equity alliances in their interaction history should display a tendency to shift from equity to non-equity, or vice versa, according to a recognizable pattern. In the absence of such a pattern, there is no evidence for equity or non-equity contracts offering superior protection from partner uncertainty. Hence the appropriateness of excluding from the analyses dyads that organized their interactions according to one governance form only throughout their interaction history. Nonetheless, in order to test for the possibility that the results of the fixed-effects models might be biased by the exclusion of dyads that only formed either equity or non-equity alliances, I performed fully specified random-effects models using different configurations of the sample. These models produced remarkably robust results, regardless of the exclusion of given sets of dyads, thus indicating that the results obtained with the fixed-effects models were not an artifact of dyad selection. The estimation of all regression models was performed in *STATA*.

The second form of observation interdependence that characterizes data of the sort used in this study concerns the relationship between the alliances formed between i and j , and alliances between i and other partners. This form of observation interdependence, which is typical of network data, requires the adoption of specific modeling approaches, such as Krackhardt's (1988) multivariate regression quadratic assignment procedure (MRQAP). Compared to alternative regression techniques, MRQAP is robust to all forms of mis-specification of the autocorrelation structure of dyadic data. MRQAP, however, could not be used in the context of our data set, since the quadratic assignment procedure (QAP) does not allow for an unbalanced panel with more than one alliance occurring between two firms in a given time period. The occurrence of multiple alliances between two firms in a given time period persisted even when the time reference was changed from the year to the month. Unbalanced panel data also prevent the use of p^* logit models, a statistical approach to the interdependence of network observations alternative to MRQAP (Wasserman and Pattison, 1996).

Given the inapplicability of extant statistical solutions to this issue, I modeled the potential interdependence of dyadic observations in the sample with a set of *ad hoc* controls. Given that this study is concerned with the relationship between the alliances formed between i and j , and alliances between i and other firms in the sample, I controlled for characteristics of firm i 's *ego network*. A social actor's ego network is the set of all actors connected to ego, and the set of ties among them, excluding the ties

involving ego itself. Two variables were introduced to control for the interdependence among *i*'s alliance ties. The first was *i*'s *ego network size*, defined as the number of firms (alters) that *i* was directly connected to. The second was the *ego network density*, given by the number of existing ties divided by the number of potential ties. Together, these variables capture some of the most fundamental mechanisms of observation interdependence in the data set. In this sense, these controls share the same principle—albeit not the same statistical precision—of p^* models, and represent the best achievable approach to autocorrelation issues in the context of these data.

For the sake of direct comparison with previous findings, I also performed logistic regressions that follow exactly, *mutatis mutandis*, the tests performed by Gulati (1995a), who proposed, and partly supported, the view that repeated interaction allows firms to progressively abandon cumbersome equity contractual forms in favor of non-equity forms of governance.

5. Results

Table 1 provides descriptive statistics for all variables. The occurrence of repeated interaction between two firms (*past alliances*) is not unusual in the sample, with a 2.24 mean, a 3.60 standard deviation and a maximum of 23. These values are induced primarily by repeated non-equity alliances (mean = 1.71, max = 18). The frequency of repeated equity deals is much lower, with a mean of 0.53, and a maximum of 7. The pairwise correlations among all variables are presented in Table 2. For the sake of readability, I have not reported the correlation coefficients for the industry dummies. Table 3 presents the results of the fixed-effects panel logit models. The first set of covariates (model 1) includes all control variables. The first group of control variables regards firm characteristics, the second introduces controls for network sources of interdependence among a firm's alliance, and the third concerns industry characteristics. The second set of covariates (model 2) introduces two predictors concerned with partners' interaction history, i.e. *past non-equity alliances*, and *past equity alliances*. The third and fourth sets of covariates (models 3 and 4) regard the nature of the activities performed within the alliance. Model 3 includes the dummy variables indicating the presence of a *licensing*, *manufacturing*, *marketing*, *R&D* or *supply component*. Model 4 substitutes the two variables for partners' interaction history, *past non-equity alliances* and *past equity alliances*, with the comprehensive variable *past alliances*. Finally, model 5 introduces the two-way interactions between *past alliances* and the five dummies for alliance content.

None of the firm characteristics in model 1 had a significant effect on the choice of governance form. The formation of equity alliances, therefore, is not associated with larger or better-performing firms. The lack of a significant effect for the variables *non-equity alliance history* and *equity alliance history* also indicates that a dyads' current choice of governance form is not affected by either of the two firms' track record of alliance formation. This suggests that firms treat each discreet governance choice as

Table 2 Pair-wise correlation of variables ($n = 1128^a$)

Variable	1	2	3	4	5	6
1 Alliance type						
2 Past alliances	-0.06					
3 Past non-equity alliances	-0.11	0.97				
4 Past equity alliances	0.11	0.71	0.51			
5 Licensing alliance	-0.25	0.03	0.06	-0.07		
6 Manufacturing alliance	0.14	-0.05	-0.07	0.03	0.00	
7 Marketing alliance	0.02	-0.05	-0.05	-0.02	-0.16	0.14
8 R&D alliance	-0.11	0.09	0.08	0.08	-0.22	0.11
9 Supply alliance	-0.15	-0.05	-0.04	-0.05	-0.08	0.02
10 Licensing × past alliances	-0.02	0.41	0.45	0.15	0.06	-0.02
11 Manufacturing × past alliances	-0.01	0.30	0.26	0.28	0.01	-0.14
12 Marketing × past alliances	0.03	0.59	0.55	0.47	-0.01	-0.01
13 R&D × past alliances	-0.04	0.76	0.71	0.60	-0.05	-0.04
14 Supply × past alliances	0.08	0.26	0.26	0.16	0.02	0.06
15 ROA	0.05	0.01	0.01	0.02	-0.08	-0.05
16 Sales	-0.03	0.35	0.32	0.32	0.07	-0.04
17 Non-equity alliance history	-0.08	0.75	0.71	0.56	0.05	0.02
18 Equity alliance history	-0.01	0.66	0.59	0.60	-0.01	0.05
19 Egonetwork size	-0.08	0.73	0.71	0.49	0.05	0.01
20 Egonetwork density	-0.06	0.61	0.59	0.44	0.02	0.03
21 Percentage of equity alliances	0.20	-0.10	-0.12	0.01	-0.09	-0.01
22 Transaction characteristics	-0.01	0.25	0.24	0.19	0.06	0.03
Variable	8	9	10	11	12	13
8 R&D alliance						
9 Supply alliance	-0.12					
10 Licensing × past alliances	-0.05	-0.01				
11 Manufacturing × past alliances	0.01	0.06	0.17			
12 Marketing × past alliances	0.03	-0.01	0.07	0.31		
13 R&D × past alliances	0.06	-0.02	0.09	0.27	0.38	
14 Supply × past alliances	0.04	-0.16	0.01	0.29	0.40	0.15
15 ROA	0.05	-0.05	-0.07	-0.01	0.03	0.01
16 Sales	0.07	-0.08	0.15	0.15	0.22	0.23
17 Non-equity alliance history	0.07	-0.09	0.33	0.22	0.44	0.56
18 Equity alliance history	0.04	-0.10	0.26	0.20	0.40	0.51
19 Egonetwork size	0.09	-0.07	0.35	0.21	0.37	0.54
20 Egonetwork density	0.09	-0.08	0.31	0.17	0.31	0.44
21 Percentage of equity alliances	-0.14	-0.02	-0.01	-0.01	-0.01	-0.04
22 Transaction characteristics	-0.05	-0.02	0.12	0.06	0.15	0.19
Variable	15	16	17	18	19	20
15 ROA						
16 Sales	-0.06					
17 Non-equity alliance history	-0.01	0.44				
18 Equity alliance history	-0.04	0.44	0.91			
19 Egonetwork size	0.00	0.41	0.76	0.74		
20 Egonetwork density	-0.01	0.34	0.81	0.77	0.90	
21 Percentage of equity alliances	-0.04	-0.11	-0.21	-0.09	-0.13	-0.14
22 Transaction characteristics	-0.10	0.46	0.26	0.28	0.25	0.19

Correlations for 28 industry dummies not reported for parsimony of presentation. Complete analyses available from the author.

^aThe 719 deals in the sample yielded 1128 dyadic observations, due to alliances involving more than two firms.

Table 3 Results of fixed-effects panel logistic regression analysis

Independent variables	Model 1	Model 2	Model 3	Model 4	Model 5
Past alliances				-0.07 <i>0.10</i>	-0.04 <i>0.10</i>
Past non-equity alliances		-0.06 <i>0.09</i>	-0.10 <i>0.11</i>		
Past equity alliances		0.31 <i>0.17</i>	0.15 <i>0.20</i>		
Licensing component			-3.75*** <i>0.67</i>	-3.77*** <i>0.68</i>	-3.69*** <i>0.75</i>
Manufacturing component			1.34** <i>0.39</i>	1.30** <i>0.39</i>	1.54** <i>0.45</i>
Marketing component			0.18 <i>0.29</i>	0.24 <i>0.29</i>	0.13 <i>0.32</i>
R&D component			-1.20*** <i>0.27</i>	-1.28*** <i>0.27</i>	-1.14*** <i>0.28</i>
Supply component			-2.74* <i>0.76</i>	-1.88*** <i>0.82</i>	-3.18** <i>1.20</i>
Licensing × past alliances					-0.02 <i>0.09</i>
Manufacturing × past alliances					-0.04 <i>0.06</i>
Marketing × past alliances					-0.01 <i>0.05</i>
R&D × past alliances					-0.04 <i>0.04</i>
Supply × past alliances					0.07 <i>0.11</i>
ROA	0.03 <i>0.02</i>	0.03 <i>0.02</i>	-0.02 <i>0.03</i>	-0.03 <i>0.03</i>	-0.02 <i>0.03</i>
Sales	0.00 <i>0.00</i>	0.00 <i>0.00</i>	0.00 <i>0.00</i>	0.00 <i>0.00</i>	0.00 <i>0.00</i>
Non-equity alliance history	0.00 <i>0.00</i>	0.00 <i>0.00</i>	0.01 <i>0.01</i>	0.01 <i>0.01</i>	0.01 <i>0.00</i>
Equity alliance history	-0.02 <i>0.04</i>	-0.05 <i>0.04</i>	-0.07 <i>0.05</i>	-0.05 <i>0.05</i>	-0.05 <i>0.04</i>
Egonetwork size	0.14 <i>0.14</i>	0.18 <i>0.14</i>	0.22 <i>0.17</i>	0.15 <i>0.17</i>	0.18 <i>0.16</i>
Egonetwork density	-0.01 <i>0.01</i>	-0.02 <i>0.01</i>	-0.03 <i>0.01</i>	-0.02 <i>0.01</i>	-0.03 <i>0.01</i>
Percentage of equity alliances	0.25 <i>2.47</i>	1.14 <i>2.68</i>	0.78 <i>2.77</i>	0.89 <i>2.80</i>	0.53 <i>2.89</i>
Transaction characteristics	-7.02 <i>5.10</i>	-7.73 <i>5.15</i>	-16.10 <i>6.12</i>	-12.16 <i>6.63</i>	-15.77 <i>6.17</i>
<i>n</i>	615	615	615	615	615
Number of groups	117	117	117	117	117
Log likelihood	-216.55	-214.68	-162.93	-163.56	-157.54
χ^2	56.38**	60.13**	163.63***	162.36***	174.41***

All models estimated with 28 industry dummies. Standard errors in italics. * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$ (two-tailed).

independent, and do not display a permanent and systematic 'preference' for a given alliance form. The variables constructed to control for the potential autocorrelation structure of the data did not have a significant effect. These results suggest that, in the context of this specific data set, the interdependence among alliances involving a given firm was not of great concern. This is in no way a statement applicable to alliance relationships in general. Since it cannot be assessed *a priori*, a modeling approach that addresses the potential interdependence of dyadic observations is always appropriate.

For parsimony of presentation, Table 3 does not include the coefficients for the last set of controls—industry characteristics. Overall, the results of this part of the analysis suggest that a few industries vary systematically in the incidence of equity alliances. Firms operating in service sectors (such as *radio broadcasting stations* or *computer maintenance and repair*) are less likely than average to enter equity alliances. Conversely, firms operating in manufacturing industries (such as *radio and TV communications equipment*) are more likely than average to chose equity governance structures for their alliances. Overall, however, these industry-level effects were rather rare in this sample. Not reported is also a complete set of two-way interaction among industry dummies and dummies for alliance content, which controlled for industry-level variation associated with different types of activities. Although a few of these interactions were significant, their inclusion did not change the main effect of alliance content on the choice of governance form (models 3–5), indicating that types of alliance activities display systematic characteristics *across* industries. Finally, the industry-level frequency and asset specificity of transactions (*transaction characteristics*) were not associated with the choice of equity.

Across models 2–5, the variables for the history of interaction between two firms were insignificant, thus providing no evidence of a pattern of evolution from a form of governance to another. The diametrically opposite result characterizes the set of dummy variables for the content of the alliance (models 3–5), which presents strongly significant associations with the choice of governance form across all models. Specifically, consistently with H1 the presence of a licensing component was negatively associated with the probability of forming equity alliances. Similarly, supply activities had a negative relationship with the selection of equity arrangements, consistently with H2. Conversely, the positive coefficient for the *manufacturing component* dummy in model 3 suggests that the performance of manufacturing activities increases the likelihood of equity forms of governance, as predicted in H3.

The negative effect of R&D goals on the formation of equity alliances emerging from this study mirrors the findings of Pisano *et al.* (1988). Other research, however, has documented a positive association between R&D activities and the formation of equity agreements (Pisano, 1989; Gulati, 1995a). These divergent results support the conclusion that the relationship between R&D collaboration and governance form is not unidirectional. Rather, it depends on the levels of task and strategic uncertainty associated with the idiosyncratic set of activities performed within a specific alliance relationship. Finally, the existence of a marketing component in the alliance did not

have a significant effect on its governance form, consistently with the arguments put forth in this study. Overall, the introduction of the variables for alliance content produced by far the largest improvement of fit from the base model, as indicated by the models' log likelihood and associated χ^2 coefficient. In contrast, none of the interaction effects in model 5 was significant, thus providing no evidence for a moderating effect of partner uncertainty on the relationship between task/strategic uncertainty and governance form. An additional set of two-way interaction effects among the other two measures of past interaction (*past non-equity alliances* and *past equity alliances*) and the dummy variables for alliance content were also not significant (not reported for parsimony of presentation).

Models comparable to the logistic regressions performed by Gulati (1995a) produced results dramatically different from those of the original study (Table 4). Gulati (1995a) had found a negative relationship between the overall number of prior alliances and, specifically, the number of prior equity ties and the likelihood of forming an equity alliance, while not finding support for the prediction that prior non-equity alliances decrease the likelihood of an equity alliance being formed. I found exactly the opposite. The coefficient for *past alliances* in model 6 shows no evidence of a relationship between the number of past alliances and the probability of forming an equity relationship. The coefficients for *past non-equity alliances* and *past equity alliances* in

Table 4 Supplemental analyses: results of logistic regression analysis

Independent variables	Model 6	Model 7
Past alliances	-0.03 <i>0.02</i>	
Past non-equity alliances		-0.24*** <i>0.04</i>
Past equity alliances		0.63*** <i>0.09</i>
R&D	-0.46** <i>0.15</i>	-0.52** <i>0.16</i>
Percentage of equity alliances	2.28** <i>0.89</i>	1.65 <i>0.88</i>
Year	-0.03 <i>0.03</i>	-0.02 <i>0.04</i>
<i>n</i>	1128	1128
Log likelihood	-592.99	-563.71
χ^2	122.70***	181.28***

All models estimated with 28 industry dummies. Standard errors in italics. * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$ (two-tailed).

model 7, however, suggest that prior non-equity and prior equity ties, respectively, decrease and increase the likelihood of forming an equity alliance. As they did not account for unobserved heterogeneity, all of the results just described are potentially spurious, as they estimate inaccurately the influence of past alliances on decisions regarding the governance structure of current alliances. It is not surprising, therefore, that the fixed-effects panel logit models (Table 3) portray a vastly different situation.

6. Discussion and conclusion

In this study, I aimed to put functional considerations at the forefront of decisions concerning the organization of the alliance relationship, while challenging the primary role typically attributed to behavioral concerns in such decisions. The results provide support for the propositions underlying this study. On the one hand, task and strategic uncertainties associated with the activities encompassed by the alliance emerge, in this sample, as the only set of predictors that reliably and powerfully determined the choice of alliance governance. On the other hand, no support was found for the alternative view of partner uncertainty as either a direct determinant of governance form, or as the moderator of the relationship between task and strategic uncertainty and the choice of equity arrangements.

These results challenge the notion according to which, over time, trust developed through repeated interaction allows alliance partners to give up the hierarchical control offered by equity forms of governance in favor of the trust-based flexibility of non-equity alliances (Gulati, 1995a). The large discrepancy between these results and previous ones is rooted in theoretical and methodological factors. Theoretically, prior research was based on the problematic assumption that equity governance provides partners with more control. Prior research also did not take fully into account alternative explanations of the choice of governance form, with discussions of task and environmental characteristics being somewhat marginalized. Notable exceptions to this rule have appropriately brought the task back in the picture (Gulati and Singh, 1998), but have done so without reconsidering the role of partner uncertainty, or taking into account the role of strategic uncertainty.

The results of the present study, however, only constitute a first step towards a reconceptualization of the role of trust and social-structural mechanisms in the governance of inter-firm relations. Specifically, my focus on the equity/non-equity dichotomy, which has informed much research on alliances, was motivated by the need for direct comparison to past work. However, this dichotomy may simply not be the most relevant when it comes to the role of trust in interfirm relationships. Partner uncertainty may be of little consequence for the choice between equity and non-equity arrangements, but may nonetheless affect aspects of the management of alliance relationships—such as the micro-structuring of day-to-day activities—that may not be captured by the coarse distinction between equity and non-equity contractual tools. Additionally, these findings do not undermine the role of partner uncertainty in the

general choice between market, hybrids, and hierarchy, as posited in TCE (Williamson, 1991). For instance, by virtue of eliminating the partners' autonomous status, and the continuous incentives to defect that stem from it, mergers and acquisitions offer distinct protections against the appropriation concerns that potentially plague both equity and non-equity alliances.

Methodologically, this study demonstrates the limitations of models of the choice of governance form that do not account for unobserved heterogeneity in firm behavior. When investigating the evolution of the relationship between two firms, such a methodological gap renders any statistical testing inaccurate, thus undermining the interpretability of prior empirical results. Neither this study nor previous ones, however, treat the history of interaction between alliance partners with an understanding of the step-by-step evolution of their relationship over time. All that our methods allow us to use is information on the overall history of interaction between two firms, without any insight into how this relationship changed, progressed, regressed or simply fluctuated from one deal to the next. While a holistic observation of interaction history still provides us with interesting insights, the identification of methods that allow for an analysis of the detailed patterns of evolution of inter-firm relationships would enhance our understanding of the dynamics of alliance relationships.

Potential methodological issues also arise in regards to the role of asset specificity in the relationship between uncertainty and the choice of equity governance forms. One of the vexing empirical problems in the TCE literature pertains precisely to the measurement of asset specificity. In two extensive reviews of the empirical research in TCE, both Shelanski and Klein (1995) and Boerner and Macher (2001) pointed out that asset specificity is often measured with proxies, such as fixed costs or capital intensity, that may be too coarse to capture whether an investment has alternative value outside the transaction. While the use of proxies may be a necessary evil in studies of hundreds of inter-firm transactions, these very imperfect measures often 'make interpreting empirical results extraordinarily difficult, [so that] it is virtually impossible to discern if the observed effect results from transaction cost considerations or other confounding factors' (Boerner and Macher, 2001: 37). For this reason, I opted to control for the role of asset specificity indirectly by assessing the consistency of my findings with the predictions of TCE, rather than directly with potentially highly problematic measures of asset specificity. The validity of my conclusions regarding the role of asset specificity hinges of course on of the quality of the measurement of partner uncertainty. In contrast with the difficulty of measuring asset specificity satisfactorily, the theoretical and empirical bases for using past transactions as a proxy for partner uncertainty are very solid, thus bringing credence to the approach I chose. Nonetheless, future research would benefit from a direct assessment of asset specificity as an alternative mechanism for the choice of governance form in alliances.

Similarly, the measurement of task and strategic uncertainties based on the functional goals of the alliance (i.e. licensing, supply, manufacturing, marketing and R&D

activities) is not optimal. The variability in the levels of uncertainty across alliances could be captured more fully with distinct measures for the task and the strategic environments. However, while there is likely to be variability in the levels of uncertainty within types of activities, much of this is between-industry variation that is accounted for in this study. What this analysis does not account for are deal-specific differences in the levels of task and strategic uncertainty within types of activities. Future research should attempt to perform finer analyses of the deal-specific content of alliance relationships. Nonetheless, the strong support for the predictions put forth in this study suggests that, controlling for industry differences, the inter-modal variation between types of activities is larger than the intra-modal variation within types of activities.

The issue of industry-level and alliance-level variability highlights the characteristics of the sample as another potential reason for the discrepancy between the results of this study and those of prior research. Specifically, while the sample used by Gulati (1995a,b) included European, Japanese and American firms, the sample used in this study is composed exclusively of US companies. There is indeed evidence that interfirm trust may play different roles in international collaborative relationships (e.g. Mowery, 1988). Unfortunately, a test of the moderating effects of partner nationality on the relationship between trust and governance form was not within the scope of Gulati's studies (1995a,b). However, if neither equity nor non-equity arrangements dominate the alternative as mechanisms to manage uncertain partner behavior, we should not expect the higher need for partner trust typical of international collaborations to affect the choice between equity and non-equity governance form. Nevertheless, future research pushing ahead the reconceptualization of the role of partner uncertainty in alliances would find in international collaborations an especially interesting arena for the study of how trust affects the management of alliances in ways that are not captured within the traditional equity and non-equity dichotomy.

The general association between task and strategic uncertainty and governance form documented in this study does not exclude the possibility that managerial perceptions of uncertainty may vary systematically, leading to strategic choices that do not conform to any objective or homogenous assessment of uncertainty (Child, 1972). There is indeed evidence for variation in managerial perceptions of uncertainty (Downey and Slocum, 1975). In this sense, what I documented is an average pattern of managerial choice across potentially heterogeneous perceptions of task, strategic and partner uncertainty. However, managers hardly develop their perceptions in a vacuum, as 'cognition is the most socially-conditioned activity of man' (Fleck, 1935). The institutional and social context plays a critical role in shaping collective interpretations and shared cognitive models, so that regularities can be observed in the behavior of organizations in cognitively-salient organizational fields, with industries often being a powerful categorization logic (Porac and Rosa, 1996). By controlling for industry-level variation, therefore, I accounted for a significant source of variation in managerial cognition.

Overall, the results of this study serve as a reminder of the critical importance of

functional determinants of economic action which have often been relegated to the background in recent developments of inter-organizational research in favor of behavioral determinants and related notions of opportunism, trust and embeddedness. The emphasis on social-structural explanations induced by Granovetter's theory of embeddedness (1985) has been a necessary correction of an 'under-socialized' view of interfirm behavior that ignores the networks of social relations within which organizations operate. However, equally great perils exist in drawing an 'over-socialized' portrayal of organizational action—one, that is, where organizations are driven largely by the preoccupation with the intentions of potential partners, rather than by the functional goals they wish to pursue through their collaboration with them.

This illustration of the over-reliance on partner uncertainty as an explanatory mechanism of interfirm behavior, however, is not meant to indiscriminately dismiss either transaction cost economics or structural explanations of economic action. This study challenges *specifically* the relationship between partner uncertainty and the choice of equity vs. non-equity governance forms in alliances, and generally raises doubts about the *universality* of the effect of trust on business transactions. This critique, however, wants to encourage the reformulation—not the elimination—of partner uncertainty and trust as central factors in organizational action. The extant body of research does offer persuasive theoretical arguments and empirical evidence documenting the role of appropriation hazards in the governance of economic transactions (Shelanski and Klein, 1995; Boerner and Macher, 2001). Similarly, much support exists for a view of social structure as constraining, supporting and derailing a variety of goal-seeking interfirm behaviors through trust and reduction of partner uncertainty (Gulati, 1995b; Uzzi, 1996; Gulati and Gargiulo, 1999). However, this emphasis on behavioral uncertainty has obscured other, quite critical, mechanisms for organizational action. These mechanisms used to figure prominently in organizational discourse, but have been increasingly marginalized in the last three decades of organizational research. Pfeffer (1997) suggested that such fading of theoretical perspectives is, in part, a function of the attraction to the new and unique in organizational studies, which does not reward follow-through on a cumulative research program, but rather the pursuit of novel perspectives that break with past research. The results of this study encourage organizational scholars to produce portrayals of organizational action where the pursuit of new ideas and theoretical perspectives comes with a balanced appreciation for the contributions of the past.

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