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Collaborative by Design? How Matrix Organizations See/Do Alliances

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Abstract. This study develops and tests a conceptual framework that analyzes how and why a firm's experiences with complex intraorganizational structures (i.e., matrix) will affect its propensity to enter into, and ability to manage, complex interorganizational structures (i.e., alliances that are multilateral, multifunctional, or involve diverse industry partners). We posit that managers of matrix firms' greater familiarity with coordination, knowledge sharing, and conflict management challenges in intraorganizational collaboration gives them greater confidence in their ability to manage similar challenges in complex alliances. Using a combination of quantitative data analysis and semistructured interviews, we find support for our core prediction that matrix firms are more likely than nonmatrix firms to enter into complex alliances. Unexpectedly, we find that the stock market penalizes matrix firms that engage in multifunctional alliances, a phenomenon we suggest reflects a "double-complexity discount." The double-complexity discount refers to reduced organizational outcomes incurred for the simultaneous complexity of intra- and interorganizational governance structures. This study raises questions about the benefits and costs of firms' simultaneously engaging in complex intra- and interorganizational governance structures, with particular attention to the difference between managerial confidence and competence regarding complex collaboration challenges.

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Keywords: matrix • organizational design • alliances • performance • interorganizational relations • coordination • power • knowledge • conflict

Introduction

Considering the growing prominence and relevance of interorganizational alliances, it is not surprising that strategy and organizational scholars have devoted significant effort to investigating the antecedents and consequences of such relationships. The ensuing research identified central challenges found in alliances, such as coordination difficulties, knowledge-sharing limitations, and power struggles. Numerous qualitative studies of complex alliances feature vivid descriptions of such challenges in multilateral alliances (e.g., the SEMATECH alliance), international alliances (e.g., the NUMMI joint venture between General Motors and Toyota), and alliances with significant functional scope and integration demands (e.g., the Renault-Nissan Alliance) (e.g., Browning et al. 1995, Inkpen 2008, Albers et al. 2016).

The aforementioned challenges are seen as having a potentially strong adverse effect on both alliance behaviors and outcomes, including deterring prospective

partners from allying and constraining their ability to create and capture value in an alliance. This has led scholars to consider specific ways in which organizations might mitigate the problems caused by these common challenges, including installing various contractual and alliance-specific governance arrangements (Reuer and Ariño 2007, Hoetker and Mellewigt 2009). Scholars have also highlighted how prior alliance experience, by providing the opportunity for firms to accumulate learning, can enable experienced firms to more confidently (and perhaps competently) pursue additional alliances (Wang and Zajac 2007).

While these earlier contributions demonstrate the value of interorganizational design considerations and prior alliance experience in mitigating alliance challenges, we suggest that there exists another valuable, but largely unexplored, antecedent: namely, a firm's *intraorganizational* design and experience. Specifically, we advance and test the notion that a firm's experience with complex internal structures, such as a matrix

organization, with its comparatively high requirements for coordination, knowledge sharing, and power/conflict management skills valued in alliances, can provide matrix firms' managers with a strong degree of confidence and possibly competence to engage in complex alliance structures.¹ We define complex alliances as those that engender multifaceted and intricate collaboration challenges, in line with the classic view of complex organizations (e.g., Galbraith 1973, Perrow 1986). Such alliances include those that have multiple partners, those that are geographically or functionally diverse, and those in which a focal firm occupies a noncontrolling ownership position.

While our theoretical approach linking matrix use to alliance behaviors and outcomes is original, we also see connections to ideas in extant work on resource dependence, including the notion that formal organizational structure affects how an organization relates to actors in its external environment. For example, Pfeffer and Salancik (1978) noted that an organization's internal structure of authority can affect how the organization approaches external interest groups and resource holders and which ones it prioritizes. Similarly, research on boundary spanners and stakeholder management has suggested that an organization's formal internal structures shape and channel interactions with actors, not just within the organization but also beyond organizational boundaries (Leifer and Delbecq 1978, Perrone et al. 2003).

We focus specifically on how and why a firm's internal use of a matrix structure, defined as formal structures characterized by dual (or multiple) authority relationships and lateral influence and communication, will affect that firm's propensity to engage in specific types of alliances. In terms of mechanisms, we suggest that a firm's experience with matrix structures will provide both a heightened awareness of the potential upside of a strategic alliance and greater confidence in the firm's ability to mitigate risks associated with alliance challenges. Taken together, these mechanisms lead us to predict that firms using matrix structures will be more likely to pursue alliance structures typically viewed as complex.

Our focus on matrix structures, which reflects a highly relationally centered organizational form, is also by design. A matrix structure—with its multiple, informal links across customer groups and functional, geographic, and product domains of the firm, as well as its limited influence of central authority—represents a functional form that encourages an organization's members to increase communication and coordination across organizational boundaries, promote knowledge exchange and learning, and foster tolerance for conflict and trade-offs (Knight 1976, Larson and Gobeli 1987). Matrix structures, much like alliance structures, are often criticized for being complex, cumbersome,

and costly (e.g., Stevenson and Moldoveanu 1995, Galbraith 2007). These omnipresent challenges in matrix firms suggest a platform for organizational learning, whereby managers of firms with matrix experience would likely be more confident in their ability to handle more complex and relationally demanding alliances such as those involving multiple and diverse partners.

In short, we anticipate that matrix structures engender managers' confidence to manage isomorphic external structures. While we expect that firms using matrix structures will consider themselves particularly capable of mitigating the frequently cited concerns regarding interorganizational collaboration, we also recognize the challenges of learning to collaborate effectively in matrix organizations, as well as the potential hurdles of applying pertinent knowledge to interorganizational collaboration (Galbraith 2007, Burton et al. 2015a). This leads us to examine more closely the extent to which greater confidence stemming from using an intraorganizational matrix structure also implies greater competence in managing complex alliances, as indicated in an alliance performance benefit.

The present study contributes to the body of knowledge on organizational design (Nadler and Tushman 1997, Goold and Campbell 2002, Greenwood and Miller 2010) by extending the analysis of formal organizational design to include interorganizational structures and outcomes. Specifically, we explore how three core elements associated with matrix organizational design—coordination, knowledge sharing, and conflict management—shape collaborative action across organizational boundaries. We also contribute to work on the social structures of markets and the antecedents and consequences of interorganizational relationships (e.g., Gulati and Gargiulo 1999, Powell et al. 2005, Gulati et al. 2012a). We do so by systematically examining how the firms' internal organizational structure and the concomitant relational arrangements among various parts of the firm affect its propensity to enter into and benefit from interorganizational arrangements. We suggest that the social structures of markets are shaped not only by the opportunities and constraints delineated by the architecture of the interorganizational network, but also by those inherent to the architecture of the *internal* design of the participating organizations. Finally, in exploring the relatedness of intra- and interorganizational phenomena, we also see the present work as relevant to prior research on the possible opportunities in, and the limits to, the transferability of organizational knowledge when firms apply their accumulated knowledge to related, yet distinct, contexts (Zollo and Reuer 2010, Perkins 2014). Specifically, we aim to enhance scholarly understanding of organizations' ability to manage isomorphic organizational structures situated within and across organizational boundaries.

Matrix Design as an Enabler of Interorganizational Collaboration

Matrix organizational structures constitute a significant departure from traditional functional, geographic, or product-oriented hierarchical structures in organizations. Functional or divisional hierarchies are organized around the principle of unity of command, so that each employee has only one boss, and authority runs in an unbroken line from the manager to the subordinates (Fayol 1949). Matrix structures differ in that they constitute a multiple command system, wherein each activity has two or more lines of command. For example, both a functional and a product manager could exert partial authority over the subordinate in a matrix (Davis and Lawrence 1977). More generally, typical matrix forms can combine functional, product, customer, or geographic dimensions, resulting in two or more lines of command.

The unique features of matrix structures enable firms to address complex tasks for which other structural forms are comparatively ill equipped. Matrix scholars have argued that “matrix is as much or more a change in the behavior of the organization’s members as it is a new structural design” (Kolodny 1981, p. 18). Specifically, matrix structures not only reconfigure reporting relations in the firm, but frequently lead to a fundamental shift in how actors behave and engage in those relationships (Bartlett and Ghoshal 1990, Galbraith 2007, Hall 2013). A recent Gallup survey of approximately 4,000 U.S. employees further supported the view that matrix structures foster closer collaboration and engagement in work relationships (Bazigos and Harter 2016).

However, studies of matrix organization have also documented challenges and costs associated with structural complexity and required behavioral change. For example, Burton et al. (2015a, p. 39) noted: “For individuals and teams, many things are challenging at the [matrix] junction points: too much information or lack of correct information; heavy workloads; conflicting goals and superiors; time orientation differences; incentives incompatibility; and so on.” This evidence suggests that the coveted performance outcomes associated with an intraorganizational matrix design are by no means assured. Guided by these insights, we therefore consider whether matrixed firms become more willing to enter into more complex types of interorganizational collaboration and more able to succeed in them. Below, we elaborate on the three distinct enablers of collaboration *across* organizational boundaries that may lead the managers of matrixed companies to feel more confident in facing the demands related to coordination, knowledge-sharing, and power conflicts with external partners. We then address the possible performance consequences of such actions.

Coordination Across Boundaries

A matrix structure effectively constitutes a “web of [intraorganizational] relationships” (Mee 1964) that connects and integrates differentiated segments of the organization and thus helps foster internal cross-boundary coordination. Coordination in this context refers to the ability of an organization’s actors to manage distributed activities to address interdependencies in the workflow. Matrix organizations’ frequent lateral exchanges lead individuals to habitually communicate beyond functional, geographic, or other organizational boundaries and involve individuals from outside their own department when deliberating on and implementing strategic decisions. This dynamic helps avoid common silo tendencies (Katz 1982), whereby individuals communicate increasingly inside of their functional or product group at the expense of communicating outside the group. By regularly reaching across organizational boundaries, individuals routinely become aware of nonobvious interdependencies among different organizational members’ activities, which is an important prerequisite for coordination. Because matrix organizations reveal interdependencies through direct interactions among specialists, and not through a mediated process involving a supervisor, organizational members also learn how to *collaboratively* develop solutions to the identified interdependencies. This local resolution of coordination challenges has been identified as a critical and differentiating aspect of matrix management (Galbraith 1971, Cleland 1981, Hall 2013).

The formal connections established among actors from different organizational units also help build social capital. The managers from matrix organizations interviewed for the present study referred to the informal relations among actors as the “soft matrix” that co-evolves with the formal reporting relationships, meetings, and decision-making procedures of the “hard matrix.” The emergent informal relationships across boundaries further enhance the organization’s information carrying capacity, thus making it more likely that actors identify and address coordination challenges that are not yet on the organization’s radar and not yet part of the formal workflow (Galbraith 1971, Joyce 1986). Some studies further suggest that matrix managers become particularly adept at empathy and anticipating their counterparts’ needs, often proactively reaching out to them before encountering coordination problems (Knight 1977, Sy and Côté 2004).

We suggest that the enablers of internal coordination within a matrix organization have unique relevance for managing coordination across organizational boundaries in alliances. Consider that alliances critically rely on effective coordination across organizational boundaries (Gulati et al. 2005, 2012b). Partners in interorganizational collaborations need to identify human and material resource needs, locate and use available

resources across multiple areas of partner organizations, and align and adjust partners' actions for the collaborative effort. All of these activities require extensive information exchange to identify and resolve interdependencies. Yet alliance partners must often overcome considerable coordination hurdles, as differences in cultures, vocabularies, standard operating procedures, and descriptions of roles and responsibilities among organizations can complicate and impede communication (Lavie et al. 2012).

To channel communication and efficiently connect individuals across organizational boundaries, alliances often install formal governance mechanisms in the form of structures and procedures. However, formal governance mechanisms alone are often insufficient, in part because the sheer complexity of many collaborative ventures precludes partners from fully determining coordination needs *ex ante* (Gerwin 2004, Mayer and Argyres 2004). Partnerships, therefore, greatly benefit from flexible, informal relationships that facilitate informal communication and joint decision making (Faems et al. 2008).

Under these circumstances, it is reasonable to expect that when contemplating alliance formation, matrix managers see superior support for interorganizational collaboration. Through both selection and socialization, actors operating in matrix structures grow to rely on informal relationships to facilitate coordination across departmental boundaries. Matrix managers are accustomed to anticipating and dealing with diverse departmental and functional values and expectations (Larson 1992) and are comfortable reaching out to potential partners and cultivating informal communication channels. In sum, we expect that managers operating in matrix structures will view coordination needs engendered by interorganizational collaboration as more ordinary and commonplace than would managers in nonmatrix structures. With continuous exposure to coordination-demanding environments, matrix managers are also more likely to see themselves as prepared to tackle these challenges and anticipate greater levels of organizational support in dealing with them.

Knowledge Sharing Across Boundaries

By fostering interactions across pockets of diverse organizational activities, matrix organizations facilitate expedient information exchange to coordinate a specific task and have a more fundamental effect on organizational members' mutual understanding and their ability to share and integrate diverse knowledge. Scholars hinted at these benefits when they noted that matrix organizations uniquely enable actors to identify technological opportunities and generate creative solutions (Larson and Gobeli 1987) and promote organization-wide learning (Hobday 2000). Some prior research has linked these benefits to matrix managers' exposure to

a wider set of problems and situations at work. Indeed, through interactions with diverse others, matrix managers develop awareness of internal resources and opportunities for knowledge sharing, enhance their adaptive responsiveness to uncertainty and emergent problems, and improve their absorptive capacity (Knight 1977, Larson and Gobeli 1987). The fluidity of matrix collaboration makes the continuous flow of heterogeneous knowledge both normal and valued, and regularly prompts managers to share and discuss specialized knowledge with nonspecialists in diverse teams (Knight 1976). For example, one of the matrix managers we interviewed described how each of the managers connected in the matrix systematically reported their perspectives and their recommendations for important strategic initiatives, including alliances. These accumulated reports then became the basis for joint discussions and decision making.

To explore how such knowledge-sharing dynamics of matrix organizations can enable interorganizational collaboration, it is important to recognize that numerous studies have identified the importance of interorganizational knowledge sharing for managing alliances. In research and development partnerships, the exchange of knowledge may represent the most central objective of the alliance. In others, knowledge sharing can play a critical supporting role, wherein partners must learn about each other's expertise, resources, and work processes to work effectively toward value creation. For example, a joint manufacturing partnership would typically include the exchange of knowledge related to the nature of partners' manufacturing facilities, existing equipment, and personnel, as well as procurement, inventory management, and quality control practices.

To share knowledge effectively, interorganizational partners may have to overcome incomplete or erroneous perceptions about partners' resources and capabilities (Doz 1996, Reuer et al. 2002). They must work toward developing a common knowledge base and shared language—prerequisites for knowledge sharing and developing interorganizational routines (Zollo et al. 2002). Matrix managers' internal exposure to diverse sets of knowledge enhances their ability to identify relevant knowledge and potentially augments their confidence and ability to absorb that knowledge. Thus, matrix managers' exposure to diverse knowledge and intermediating knowledge exchanges among diverse internal groups could make them more confident to embrace knowledge-sharing challenges in interorganizational partnerships.

Managing Power and Conflict

Studies concede that the overlapping authority demands in matrix structures can engender power struggles and conflicts over resources, roles, technical issues, and personnel assignments (Barker et al. 1988). Some scholars

have noted, however, that these inherent tensions are, to a degree, intentional. Galbraith (1971, p. 36), for example, suggested that the problems matrix organizations face are inherently “uncertain and must be solved on their own merits—not on any predetermined power structure.” Hence, matrix structures, rather than prescribing a fixed distribution of decision-making power in the organization, retain some ambiguity of power and require flexible, adaptive, and situational conflict resolution approaches.

Extant research has further suggested that these inherent tensions and ambiguities in matrix structures create a particular outlook in the organization on conflict and shape a distinctive “organizational culture characterized by multiple authority–responsibility–accountability relationships” (Cleland 1981, p. 48; emphasis added). This culture, defined by a combination of behavioral norms and expectations, enables organizational members to engage in deliberate conflict, and to lead and motivate team members through informal influence, exchange, negotiation, and reciprocity (Jones et al. 1994, Foss 2003). Davis and Lawrence (1977, p. 87) noted, for example, that “project and business managers [in matrix organizations] do not unilaterally decide. They manage the decision process so that differences are aired and trade-offs are made in the interest of the whole.” These deliberate conflicts are often seen as crucial for the self-selection and socialization of organizational members and as beneficial for building intraorganizational networks. As a result, matrix managers learn to live not only with the relative unpredictability of interactions and roles in the organization, but also with the essentiality of dealing with power tensions and conflict.

It is important to note that matrix structures and interorganizational partnerships mirror each another in that organizational actors in them are forced to deal with split authority and the resulting conflicts. Alliances involve two or more independent entities and thus epitomize split authority structures, where issues of power become central (Gulati and Sytch 2007). Specifically, involved alliance managers must interface with the management of two or more partnering organizations and reconcile their conflicting agendas regarding goals, scope, resource allocations, and the distribution of rents in the partnership.

Considering the preceding arguments, it is therefore reasonable to expect that, in contrast to managers of nonmatrix organizations, managers of matrix firms will view power struggles and conflict in interorganizational collaboration as more quotidian. In other words, matrix managers are more likely to regard conflict as a normal aspect of collaborative efforts rather than a sign of relational breakdown and bad faith. As such, they will approach possible interorganizational conflict with less trepidation and greater confidence and pragmatism. Furthermore, matrix managers can draw

parallels between conflict challenges in alliances and their experience with internal power struggles and conflict, as well as their ensuing abilities to resolve conflict through informal influence, negotiation, and reciprocity.

Matrix Firms’ Partnership Formation

Considering matrix structures as sources of continuous exposure to coordination and knowledge sharing, as well as internal power and conflict demands, we expect matrix managers to be more confident than their nonmatrix counterparts in facing comparable challenges in interorganizational collaboration. Matrix managers will both treat them as regular accompaniments to collaboration and expect to apply lessons internally when dealing with these challenges across organizational boundaries. As a result, we anticipate that by alleviating concomitant ex ante collaboration concerns, matrix firms will be more likely than nonmatrix firms to enter into interorganizational partnerships, where coordination, knowledge-sharing, and conflict-management demands are particularly pronounced.

Among many forms of interorganizational collaboration, multilateral alliances have been frequently singled out as featuring some of the most challenging requirements for coordination and knowledge sharing. For example, consider SEMATECH, the research and development consortium of 14 U.S. semiconductor firms established in 1986 to improve the industry supply base and manufacturing processes. It initially struggled to reconcile the different management approaches and technological standards of its member organizations and to align member firms’ investments and supplier development strategies to achieve structural change in the U.S. semiconductor industry (Browning et al. 1995). A multilateral alliance in which a firm must interact with multiple partners has more information to exchange, evaluate, and, in many cases, reroute and broker to various individuals internally and within the partner organizations. Even if not all partners of a multilateral alliance are involved in all aspects of the collaborative venture, the partners must still determine which partners will be involved when and which tasks and decisions can be delegated to which partners. All of the decisions represent a considerable coordination challenge, even in the case of a triadic multilateral alliance, in which the number of potential coordination and knowledge-sharing relationships is three times that of a basic bilateral relationship. Matrix organizations’ information carrying capacity, their numerous and routine lateral channels of communication, and their tendency to involve many diverse individuals in communication and decision-making processes could provide their managers with the necessary confidence to deal with the complex information flows in multilateral alliances.

In addition to managing coordination, matrix managers’ exposure to conflict management internally is

important in the context of multilateral alliances. When a firm simultaneously deals with multiple partners, conflicts of interest and disagreements about relative priorities, resource commitments, and decision-making procedures become more common and complex. In particular, multilateral ventures are likely to subject managers to a multiple-role situation, with conflicting and at times confusing expectations (Kahn et al. 1964, Li et al. 2012). Against these demands, consider that the managers of matrix organizations could feel equipped to deal with power struggles and conflicts over resources, roles, differences of opinion, and interests, usually without recourse to resolve these conflicts through authority. We therefore expect that they should be more comfortable with the prospect of potential conflictual situations in multilateral alliances. Based on these arguments, we hypothesize:

Hypothesis 1. *Matrix organizations will enter into a greater number of multilateral alliances than will nonmatrix organizations.*

Considering the enablers of collaboration inherent to matrix organizations, we expect that these organizations may also be more likely than nonmatrix organizations to form alliances with new partners. Establishing an alliance with a new partner entails significantly more risks and uncertainties compared with collaborating with a familiar, repeat partner. Among such risks are the new partner's level of cooperation and opportunism, its true intentions in the alliance, or the reliability and value of its contributions to the partnership. This is in stark contrast to collaborating with a partner with which a firm has a history of interaction, in which direct experience and observation breed familiarity and trust.

Thus, when collaborating with a new, unfamiliar partner, the firm faces concerns regarding whether the partner will prove to be compatible and whether its knowledge will be usable (Mitsubishi and Greve 2009). Furthermore, in these partnerships, firms cannot rely on established trust regarding partners' integrity and benevolence; as such, they cannot easily use relational governance mechanisms (Gulati 1995, Zaheer and Venkatraman 1995). And yet, such relational governance mechanisms are crucially important in complementing formal governance mechanisms of contracts and alliance management committees to prevent and resolve conflicts.

Considering the ways in which matrix organizations foster cross-boundary coordination and effective mitigation and conflict resolution, we anticipate that matrix managers will find the risks and uncertainties of forming an alliance with a new, unfamiliar partner less daunting. Matrix managers are accustomed to resolving non-routine coordination challenges across complex organizational interfaces that often entail coordinating with unfamiliar internal partners. Because of their

experience managing high levels of uncertainty and emergent interdependencies in their own organization, matrix managers can familiarize themselves with unfamiliar partners' structures and processes and identify emergent interdependencies of the collaborative work.

Furthermore, because the managers of matrix organizations are more accustomed to situations involving internal conflict, they are more likely to embrace alliances with unfamiliar partners, in which power struggles, conflicts, and disagreements can be both more likely and more difficult to manage (Arino and De La Torre 1998, Reuer et al. 2002). Specifically, matrix managers are more likely to see these tensions as inevitable and even necessary dynamics of the collaborative process. Indeed, they will be less likely to be deterred by the hazards of possible mistrust and low commitment when approaching possible alliances with new partners. Thus, we predict:

Hypothesis 2. *Matrix organizations will enter into more partnerships with new (previously unfamiliar) partners than will nonmatrix organizations.*

The logic of our central argument suggests that matrix managers' exposure to a coordination-demanding environment internally can be beneficial in diverse alliances. Such diversity could entail partner diversity in terms of geographic location or industry affiliation, and functional alliance diversity, such as partnerships that combine different functions in the alliance scope, including research and development (R&D), production, and marketing. It is reasonable to anticipate that companies entering such diverse alliances are more likely to encounter new and unfamiliar coordination challenges. The need to communicate across national and geographic boundaries may require more complex interface structures and make coordination gaps more likely. Similarly, functionally diverse alliances typically require coordination arrangements with a larger number of internal functions and more diverse stakeholders. Matrix managers' quotidian experiences managing complex interfaces among diverse organizational domains internally and their interpersonal connections across functions can help alleviate concerns about similar challenges that may arise in interorganizational collaboration.

High diversity among partners and alliance functions also frequently require the focal firm to identify, absorb, and integrate more diverse types of information and knowledge. Such efforts must span different national, functional, and industrial fault lines. Matrix structures expose managers to a broad spectrum of issues and knowledge sets within their organizations, which is likely to make the managers less apprehensive about acquiring and integrating diverse knowledge across organizational boundaries. Furthermore, managers of matrix organizations may be confident in their ability

to absorb, integrate, and apply knowledge inside their organizations. Indeed, these managers have cultivated networks of intracompany ties, which can help facilitate the requisite knowledge acquisition and transfer.

Finally, like any collaboration involving diverse actors, alliances with diverse partners increase the likelihood of conflicts. While partner similarity by no means guarantees perfect harmony and unanimity in an alliance, a high level of partner diversity in terms of industry affiliations and nationalities often translates into diverging expectations about private and shared alliance benefits (Khanna et al. 1998). Heterogeneous industry and cultural experiences often lead to diverging conceptions about how to manage the collaboration (Parkhe 1991, Lavie and Miller 2008). Under these circumstances, it is reasonable to expect that managers of matrix organizations are more likely to accept diverging perspectives among partners as a necessary component of collaboration. They are thus less likely to be deterred by the prospects of surfacing and resolving conflicts. In summary, we anticipate that the features of matrix organizations will make their managers less apprehensive about the coordination, knowledge-sharing, and conflict demands engendered by entering diverse alliances. Hence, we predict:

Hypothesis 3. *Matrix organizations will enter into a greater number of diverse alliances than will nonmatrix organizations.*

In addition to the effects we have hypothesized thus far, we anticipate that matrix organizations will enter a greater number of partnerships in which they will occupy a nondominant power position; that is, they will hold equal or inferior power compared with their alliance partners. Alliance power dynamics are influenced by partner characteristics, such as resource endowments or market positions, and by the partnership's governance arrangements. Firms with superior resource endowments and market positions are more likely to control more of the crucial contributions to the alliance, have more outside options at their disposal, and depend less on the success of a single alliance (Lavie 2007). Therefore, they can exercise power more freely in the partnership. Such power could manifest as threats of withholding or altering the powerful firms' contributions to the alliance or exiting the alliance altogether.

Beyond these informal bases of power, alliance governance formally regulates power in the partnership and provides levers of control. In particular, the distribution of equity stakes in the partnership often determines the formal balance of power, because the partner owning the largest equity share typically appoints more directors to the venture's board and controls much of the decision-making process (Li et al. 2009). Holding a dominant power position in a collaborative venture allows a firm to determine the allocation and transfer of knowledge, technology, and other resources, as well as the ensuing

rents. Hence, firms typically strive for a dominant power position—such as forming alliances with smaller partners or by securing a majority equity stake in an alliance—to assert their interests in the partnership.

Matrix managers, however, may prefer arrangements reminiscent of their internal collaborative dynamics. Matrix managers ordinarily operate in an environment in which power and control relationships are vaguely specified and in which fluid cooperation is expected and rewarded. In matrix organizations, traditional markers of power, such as unit size or profitability, are less consequential than in hierarchical structures for shaping decision-making processes and outcomes. Some studies have suggested that managers of matrix firms handle the demands of informal exchange through socialization and by forging psychological contracts with exchange counterparts (Chi and Nystrom 1998). As such, matrix managers could be less likely to pursue controlling equity stakes and the associated formal control in alliances, and thus be more likely than nonmatrix organizations to forego dominant power positions in alliances:

Hypothesis 4. *Matrix organizations will enter into more alliances in a nondominant power position than will nonmatrix organizations.*

We expect that matrix firms will be more likely to favor the flexibility of purely contractual arrangements over the more determinate equity-based partnerships. Forming equity-based partnerships requires companies to formalize the partners' roles and responsibilities, governance structures, and joint decision-making processes at the inception of the relationship. Studies of interorganizational partnerships generally agree that equity deals offer stronger hierarchical controls (Williamson 1975, Vanneste and Puranam 2010, Reuer and Devarakonda 2016), in part by establishing more detailed coordination provisions in contracts to limit changes that may affect payoffs and other elements of the relationship. Gulati and Singh (1998, p. 786) noted that these formal and fixed control provisions render "the interactions between partners more predictable and allow joint decisions to be made more by rules than by exception."

Although hierarchy and formal controls safeguard partners' equity investments, they also limit the partners' ability to adapt to unanticipated events. Rigid, rules-based alignment and conflict-resolution mechanisms are antithetical to matrix management's fundamental assumption that key organizational challenges cannot be addressed adequately by predetermined or unilateral mechanisms, but instead need to be solved situationally through influence and negotiation. Hence, we expect matrix managers to be more willing to forego the formal power structures of an equity deal and embrace the greater opportunities for extemporaneous adaptation and conflict resolution that nonequity deals offer.

Hypothesis 5. *Matrix organizations will enter into more nonequity alliances than will nonmatrix organizations.*

Matrix Firms' Partnership Outcomes

In our preceding arguments, we have posited that matrix managers would be less apprehensive about encountering the coordination, knowledge-sharing, and conflict-associated demands engendered by complex interorganizational alliances. We now explore the extent to which matrix firms' propensity to enter complex alliances impacts their performance in these alliances relative to nonmatrix firms. It is essential to note that measuring alliance performance constitutes a perennial scholarly challenge. In the absence of concrete and uniform indicators, most extant research has relied on using event studies that capture abnormal stock market reactions to partnership formation to evaluate alliance performance (Anand and Khanna 2000, Kale et al. 2002, Lavie 2007). Building on this work, we explore the performance implications of the alliances that matrix firms form based on two central assumptions. First, firms engage in alliances expecting a performance benefit. Therefore, a matrix firm entering a complex alliance suggests that the firm expects to generate a positive net present value from that alliance. Second, investors try to accurately predict an alliance's performance benefit for a firm and trade its stock accordingly. These predictions may be noisy,² but they nonetheless constitute a relevant external diagnostic of a firm's resource allocation choices. Thus, by examining stock market reactions, we examine whether investors share matrix managers' confidence about creating and capturing value in complex alliances.

One possible prediction is that investors recognize the benefits of matrix firms' collaborative practices for creating and extracting value from complex alliances. Given the low success rate of alliances across a variety of partner firms, investors recognize that alliances are a highly risky strategic vehicle, particularly because of their distinct relational risks (Das and Teng 1996). Investors may reasonably expect that the continuous exposure to and the concomitant learning benefits from having worked through similar challenges of coordination, knowledge sharing, and conflict management within organizational boundaries will position matrix managers to reap superior performance outcomes from complex interorganizational alliances. Indeed, complex partnerships are particularly likely to engender collaborative challenges because of their number or profile of partners, their geographic or functional scope, their governance arrangements, or the nondominant power position that the matrix firm occupies. In this regard, investors could appreciate matrix firms' proactive approach to collaborative challenges, as well as firms' opportunity to build on existing internal coordination, knowledge-sharing, and conflict-management practices as advantages. Investors

may thus anticipate that matrix firms manage the risks of complex interorganizational alliances more effectively and draw more benefits from them compared with nonmatrix firms:

Hypothesis 6. *Matrix organizations will obtain more positive stock market reactions on entering into complex alliances (i.e., involving multilateral relationships, broad geographic or functional scope, unfamiliar or diverse partners, nonequity governance, or occupying a nondominant power position) than will nonmatrix organizations.*

Data and Methods

We tested our hypotheses using a sample of 500 firms that appeared at least once in the Fortune 500 list of the largest U.S. companies based on gross revenue from 2000 to 2008. Because of the turnover of firms in the Fortune 500 list, the total number of firms that appeared in the list during the study's timeframe was 629; we sampled 500 firms from this larger set. Focusing on the largest American corporations made it more feasible to access archival data on organizational structure, partnership formation, and stock performance, as well as leverage business school alumni networks to validate the archival data and conduct field interviews.

We used the SDC Platinum database—one of the most reliable and comprehensive sources of information on alliances (Schilling 2009)—to collect data on 21,155 alliances in which the firms from our sample were engaged during the study period. We used CRSP stock market data to measure investors' response to alliance announcements. To supplement the quantitative empirical data, we interviewed several alliance managers from both matrix and nonmatrix Fortune 500 firms. Using a semistructured interview protocol, we inquired about the strategic role of partnerships for the managers' respective firms, as well as the organizational structures, processes, and talent in place to form and support the firms' partnerships. These interviews provided us with a rich account of day-to-day concerns and challenges the alliance managers faced, their responsibilities, and the nature of their interactions with both internal and external stakeholders.

Matrix Structures

Our key independent variable for predicting partnership formation choices and stock market reactions is a binary measure denoting the presence of a matrix structure in a given organization in a given year. In a typical two-dimensional matrix of a multinational corporation, a subunit manager, such as a product manager at the country level, reports to two higher-level managers, such as the manager of the corresponding product division and the general manager of the firm's operations in a particular geographic location (Chi and Nystrom 1998). Matrix structures frequently involve geography as a dimension of the matrix, and geographic segmentation is

frequently detailed in public companies' SEC filings. Therefore, we focused on identifying matrix structures with geography as one of the dimensions.

We used a four-step process to identify matrix organizations. First, we searched for evidence of dual reporting lines in the titles of directors and executive officers listed in the companies' annual reports. Specifically, we checked whether titles indicated that some senior managers were responsible for geographic segments and other senior managers were responsible for nongeographic segments (e.g., product or functional domains). For example, the 2002 annual report for General Electric lists the title of "President and CEO, GE Plastics." It similarly lists the title of "President and CEO, GE Europe." The dual reporting lines are evidenced by the presence of a title such as "President, GE Plastics, Europe." Second, we examined whether the reporting verticals (i.e., "Europe" and "Plastics" in this example) indeed correspond to meaningful hierarchical arrangements by checking whether geography-related titles matched the geographic segments from revenue or asset reporting. For each firm-year in which both conditions we satisfied, we gave the organization a preliminary coding as a matrix structure in that year. This resulted in 29 organizations with a matrix structure in at least one year from 2000 to 2007.

In the third step, we validated the accuracy of our categorization using publicly available sources. Specifically, we used Factiva, Google, and Glassdoor.com to retrieve news articles, press releases, and employee testimonials about organizational structures for 80 firms in our sample: the complete set of 29 matrix organizations and a sample of 50 randomly selected nonmatrix organizations. We found media data for 20 of the 29 matrix firms, which confirmed our categorization in all but one of the cases. Employee reviews of their employers posted on Glassdoor.com confirmed matrix structures for 23 of the matrix firms. We found media data confirming nonmatrix organization structures for 23 of the 50 randomly selected nonmatrix firms and found no disconfirming media reports.

In the fourth and final step, in 2009–2010, we validated our categorization through direct contact with executives working in the studied firms by leveraging the alumni networks of two large U.S. business schools. Specifically, we contacted senior executives who worked at 20 of the matrix firms and a random sample of executives who worked at 20 of the nonmatrix firms via phone calls and emails to request verification of the organizational structure data. The response rate for matrix and nonmatrix firms was 60% and 50%, respectively. Matrix structures were confirmed in all but one of the cases. The sole firm whose initial matrix classification was rejected based on direct information from executives at the firm was retained in the sample as a nonmatrix firm. Nonmatrix structures

were confirmed in all but two of the cases. In one of these two cases, the matrix existed in the company briefly (during 2002–2004), which was the beginning of the study's observation period. After making corresponding corrections in the data, we identified 29 matrixed organizations (see Online Appendix A). Collectively, matrix firms contributed 158 firm-year observations to our analyses and nonmatrix firms contributed 2,944 firm-year observations. The total sample size, therefore, totaled 3,102 firm-year observations.

Important to note is that research on matrix design has shown that matrix structures can be adopted at different levels in the organization (Galbraith 1971, Davis and Lawrence 1977). For example, a marketing department can internally adopt a matrix structure with product categories and customer groups as two dimensions of the matrix. Alternatively, matrix structures can be adopted at a higher level in the firm, so that multiple departments and functional groups are involved, more employees are included, and even higher-level managers have dual or multiple bosses. (In the marketing department matrix example, in contrast, the head of marketing would have a single boss.) Our matrix structure identification procedure focused on capturing matrix structures at the higher levels of the organizational hierarchy. As a result, we identify firms for which matrix management is applied across the entire organization and is not merely an isolated part of it. It is precisely throughout these organizations that matrix management is more likely to have a far-reaching effect on managers' attitudes, cognition, and behaviors. Focusing on higher-level matrix structures is also necessitated by the study's primary research question focusing on the relationship between internal organizational structures and choices of external alliance partners, which often involve decision makers at the corporate level. Furthermore, available alliance data do not consistently specify organizational units as the partnering entities; instead, they often name the entire corporation as the partner.

Dependent Variables and Estimation

The primary empirical challenge in our analysis is that the binary of a matrix structure is likely to be an endogenous variable, which could render estimates of a basic linear regression inconsistent. Because finding a proper instrument for the adoption of a matrix structure is nearly impossible,³ we used the nearest-neighbor propensity score matching approach with replacement. This approach enabled us to estimate average treatment effects (ATE) and average treatment effects on the treated (ATET) for matrix organizations on both the formation of different types of alliances and stock market returns of those partnerships versus *comparable* nonmatrix organizations.⁴ We explicate the two outcomes and the details of our matching procedures in detail below.

Formation of Alliances. Our first set of hypotheses predicted that matrix organizations would differ from nonmatrix organizations in terms of their propensity to form various types of partnerships. An empirical challenge lies in the fact that several variables, such as the market and technological characteristics of a firm's task environment, are likely predictors of *both* matrix adoption and alliance formation. For example, a high degree of geographic dispersion and technological scope of a firm's operations could increase its propensity to adopt a matrix structure to better coordinate efforts and knowledge flows across multiple domains of expertise. Such task environment complexity may also motivate firms to engage in a greater number of partnerships to access resources relevant to the market and the technological challenges they face (Eisenhardt and Schoonhoven 1996). It is also possible that the resultant partnerships would be more complex given the complex issues they are meant to address; indeed, a high degree of task environment complexity may prompt firms to engage in partnerships with firms from a broader, more diverse set of industries and geographies (Tatarynowicz et al. 2016). In addition, it is possible that the demands of complex partnerships can lead some organizations to adopt a matrix structure.

To account for variations in each firm's external task environment, we used the following variables in propensity score matching, subject to meeting the balancing property: (1) firm size, measured as the logged number of employees; (2) the firm's industry scope, measured as the firm's number of nonprimary four-digit SIC codes listed in Compustat; (3) technological scope, measured as the logged number of unique three-digit U.S. patent classes in the overall stock of the firm's patents, obtained from the U.S. Patent and Trademark Office data (additionally, we used a No Patents binary variable to account for firms with no registered patents); (4) geographic scope, measured as the logged number of countries in which the firm owns subsidiaries, based on data compiled from the LexisNexis Directory of Corporate Affiliations and the Bureau van Dijk Mint Global databases; and (5) industry fixed effects, using two-digit primary SIC codes. To account for the possible effects of complex alliances driving the adoption of an organizational structure and to pick up the residual component of the firm's external environment, we additionally matched on a firm's propensity to form complex alliances, which we measured as the cumulative number of a firm's multilateral alliances, multifunctional alliances, alliances with new partners, and partners' unique two-digit SIC codes formed over the preceding seven years.⁵ We also included year fixed effects among the matching variables to account for possible temporal variations in alliance formation patterns.

Online Appendix B displays baseline probit estimates predicting the adoption of a matrix structure.

We find that larger companies and those with a greater geographic scope of operations are more likely to feature a matrix structure. Companies above the 67th percentile on technological scope are significantly more likely to be matrixed than those without any patents. Furthermore, companies with a larger number of prior multilateral alliances are more likely to feature a matrix form. These results are intriguing in that they point to systematic factors in the firms' external task environment that can drive the adoption of matrix structures. Empirically, these results indicate that adopting a matrix structure is likely to be a systematic process and gives further credence to the use of propensity-score matching.

To test Hypothesis 1, we estimated ATE and ATET for matrix versus comparable nonmatrix organizations on the following two outcomes: (1) the *number of multilateral alliances*, which is the count of all partnerships a firm entered in a given year that involved more than two partners; and (2) *at least one multilateral partnership*, which is a binary measure that takes on the value of 1 if a firm formed at least one multilateral partnership in a given year, and 0 otherwise. Whenever multiple subsidiaries of a parent firm participated in an alliance with one or more partner firms, we counted each of these subsidiaries as a partner in the alliance. Alliances that involved only subsidiaries from a single parent firm were excluded from the data set.

To test Hypothesis 2, we estimated ATE and ATET on the following outcomes: (1) the *number of partnerships with new partners*, which is the count of all partnerships a firm formed in year t that involve partners with which the firm had no previous partnership history; and (2) *at least one partnership with a new partner*, which is a corresponding binary measure taking the value of 1 if the firm formed at least one partnership in a given year with a new partner, and 0 otherwise.

To test Hypothesis 3, we considered alliance partners' primary industry affiliation, geographic location, and the functions in the partnership. Specifically, we estimated ATE and ATET on the following outcomes: (1) the *number of partners from different industries*, which counted the number of unique two-digit SIC codes of partners with which a firm partnered in a given year; (2) the *number of countries represented by partners*, which counted the number of unique countries partners represented with which the focal firm partnered in year t ; and (3) the *number of functions designated to an average partnership*, which measures the average functional scope of the partnerships a firm formed in year t . To compute this measure, we captured the key functional orientations of every partnership a firm formed in year t , differentiating among manufacturing, marketing, R&D, licensing and royalty agreements, and supply agreements. We subsequently calculated the average number of functions for partnerships a firm formed in year t .

To test Hypothesis 4, we used two key outcome variables to capture firms' tendency to enter into partnerships from a position of power. First, we computed *size advantage in partnerships*, which is a cumulative difference between a firm's sales volume and the sales volume of partners in partnerships the firm formed in year t .⁶ A positive difference indicates that the firm tends to enter into partnerships with smaller, less powerful partners. Second, for equity partnerships formed in year t , we computed both *the number of partnerships the firm entered as a majority partner* and as a *minority partner*.

Finally, to test Hypothesis 5, we measured a firm's propensity to enter into equity and nonequity partnerships by counting the number of equity and nonequity partnerships a firm formed in year t . Equity partnerships include joint ventures, which involve partners' taking equity stakes in an independent, newly jointly created entity. They also include partnerships in which one or more partners can take a (minority) equity stake in another partner.

Stock Market Reaction to Formation of Alliances. In the present study, we regard abnormal stock returns as an expression of investors' expectations regarding the performance of the focal alliance. We calculated market-adjusted returns using the S&P 500 market index model. In our results, we report cumulative abnormal returns (CARs) for the most typically used time windows, including $[-1;0]$, $[0]$, and $[-1;+1]$, where $d = 0$ indicates the day of the partnership announcement; $d = -1$ and $d = +1$, in turn, indicate the days that immediately precede and follow the day of the announcement, respectively. To eliminate the confounding effect of other events that potentially influence stock returns (McWilliams and Siegel 1997), we filtered out observations that coincide with acquisitions, executive successions, and earnings announcements.

Our theory in Hypotheses 6 requires us to estimate the differences in CARs incurred by matrix versus nonmatrix organizations for a particular type of partnership. To do so, just as in testing Hypotheses 1–5, we continue to rely on the nearest-neighbor propensity score matching approach with replacement to calculate ATE and ATET. This approach helps us account for possible endogeneity in the adoption of a matrix organizational structure. In estimating investors' response to partnership formation, however, we need to test for what effectively is an interaction of matrix design and type of partnership. To estimate ATE and ATET in the present study's research design, we first split the sample into subsamples based on type of partnership. We then performed propensity score matching and estimated CARs *within the relevant subsample* (MacGarvie 2006).

Thus, to estimate CARs to the formation of a multilateral partnership, we first isolated the subsample of

firm-year observations in which firms formed multilateral partnerships. We then used propensity score matching to match matrix with nonmatrix firms within this subsample to estimate ATE and ATET. The unit of analysis in testing Hypothesis 6 is a given alliance. Thus, in addition to the matching variables used for testing Hypotheses 1–5, the matching probit specification accounted for the following alliance-specific characteristics: whether the partnership involved a foreign partner, the type of partnership (i.e., licensing, manufacturing, marketing, R&D, or procurement), and the number of alliance partners in the focal alliance. The exact probit specification for each subsample varied because of the nature of the tested effects and empirical constraints. For example, when estimating ATE and ATET for multilateral partnerships, we had to eliminate the count of partners from the probit matching equation, because the subsampling strategy essentially eliminated the relevant variation in partner counts. The empirical constraints, in turn, dictated that we retain controls that satisfied the balancing property and avoided perfect predictions.

Although stock market returns represent a widely used metric for measuring alliance outcomes, it is possible that such outcomes could be measured with error. The cleanest estimates of CARs occur for alliances that formed after several alliances had already been entered, thus allowing the stock market to learn how to evaluate them properly. We therefore collected data from 1960 to 2007 for all partnerships that included at least one U.S. publicly traded partner. The present study period is from 2001 to 2008, which followed the massive wave of alliances in the 1990s (Hagedoorn 2002). As a result, in 2001, which marked the beginning of the study's observation period, the cumulative stock of previously formed alliances exceeded 52,000. This signifies a considerable amount of knowledge in the stock market about the performance implications of alliances. The cumulative counts for different types of alliances (e.g., those with new partners or with partners from different industries) were all in the thousands. Furthermore, in our observation period, we could not identify any significant spikes of alliance activity, which would allow us to proxy learning through a time-series analysis of waves in alliance formation. Instead, the cumulative count of alliances rose gradually to more than 72,000 alliances toward the end of our observation period. Considering this empirical context, it was difficult to specify a function of the market's learning to predict alliance outcomes; indeed, such a function would be based on a series of strong assumptions, each of which would be subject to multiple alternatives.

Instead, we identified firms with just a handful of prior alliances and eliminated them from the estimation process, thus using a cross-sectional correction for CARs. Underlying this approach is the reasoning that as a firm enters into more alliances, the market learns to calibrate

the value of a newly formed alliance for that firm. The cumulative distribution of prior alliances formed at the firm level displayed a smooth curve, with no natural cutoff points. Following this analysis, we conservatively judged that the level of noise in CARs to alliance formation would be significant for any firms that had entered fewer than 10 alliances before the beginning of our observation period. We thus eliminated those observations, amounting to about 6% of the sample, from the data.⁷ Taken together, the following aspects of our research design help mitigate possible noise and error in the estimates of CARs following alliance formation: (1) the significant overall number of alliances formed by the beginning of the study's observation period and the likely high stock of associated knowledge in the market; (2) the large and public nature of the study's firms, which typically corresponds to greater levels of information availability and public scrutiny; and (3) the cross-sectional correction to reduce noise in CARs.

Results

Table 1 provides descriptive statistics for our sample. Table 2 reports the average treatment effects (both ATE and ATET; see Online Appendix C for the details of estimating ATE versus ATET) for alliance formation variables, both of which help explain whether matrix organizations systematically differ from their nonmatrix counterparts in alliance formation patterns. We find no significant differences between matrix and nonmatrix firms with respect to the *number* of partnerships (of any kind) they enter (Table 2, Baseline). We do find support, however, for some of our predictions regarding the *types* of partnerships that matrix firms form more readily than nonmatrix firms.

Specifically, our results indicate partial support for Hypothesis 2, which suggests that matrix firms are more likely to enter into partnerships with new partners (Table 2). And, our results strongly support Hypothesis 3, which predicts that matrix firms are more likely than nonmatrix firms to engage in diverse alliances. The results are particularly strong for alliances in which partners span a greater number of industries; there is also support for matrix firms' entering into alliances that serve a broader set of functions and span multiple countries, although weaker in the latter case. Notably, the results of testing Hypothesis 4 potentially point to a nuanced argument. It appears, consistent with our prediction, that matrix organizations are willing to relinquish *formal* power by entering into partnerships as a minority equity partner. Contrary to our expectations, however, they seem to seize *informal* power by maintaining a size advantage over their partners. Contrary to Hypothesis 1, we find no significant differences between matrix and nonmatrix firms in their propensity to form multilateral partnerships (Table 2). Furthermore, there is no evidence that matrix firms are disproportionately

more likely to enter into *nonequity* arrangements compared with nonmatrix firms, which refutes Hypothesis 5. In contrast to our expectations, matrix organizations are more likely than nonmatrix organizations to prefer equity arrangements. (We return to these results in the discussion section.)

Table 3 analyzes firms' cumulative abnormal returns in the stock market on alliance announcement. Our most robust and consistent pattern of results reveals that matrix firms incur a heavy penalty for entering multifunctional partnerships (e.g., those that combine R&D and marketing designations). These results reject Hypothesis 6 and suggest instead that investors appear to impose a "double-complexity discount" on matrix organizations pursuing complex, multifunctional alliances, perhaps based on concerns about the magnified challenges of managing the mirroring complexities of both intra- and interorganizational, cross-functional collaboration.

The remaining performance results are not nearly as consistent as those reported above and are often marginal in magnitude. Nonetheless, they potentially point to an intriguing pattern. It appears that the market may be treating matrix firms that pursue other elements of partnership complexity more favorably. For example, some evidence suggests that the market responds positively to alliances formed with partners from different industries and to alliances that the matrix firm enters as a minority equity partner. Suggestive evidence exists of the same pattern of results in matrix firms' pursuit of multilateral partnerships and alliances with new partners. Whereas matrix firms obtain *negative* stock market reactions from forming noncomplex, bilateral alliances and alliances with familiar partners, stock market returns are not statistically different from 0 for corresponding complex alliances: multilateral alliances and alliances with new partners. Again, we interpret these results with significant caution because of the levels of their statistical significance and consistency.⁸

Discussion

The present study has examined the effect of a firm's internal organizational structure on that firm's engagement in alliances and stock market reactions to the formation of those partnerships. Our tests revealed an intriguing pattern of results: consistent with our core prediction, matrix organizations are more likely to enter into complex alliances than nonmatrix organizations; however, for some alliances, they are also penalized for such behaviors by the stock market.

Our first empirical finding indicates that matrix organizations are more likely to ally with new and diverse external partners, suggesting that matrix firms are more comfortable when faced with relational uncertainty stemming from unfamiliar partners and contexts. We also find that matrix firms are less daunted by alliances

Table 1. Summary Statistics

	Variable	Mean	Standard deviation	Minimum	Maximum
1	Number of partnerships formed in <i>t</i>	1.68	4.14	0	73
2	Number of multilateral partnerships formed in <i>t</i>	0.03	0.19	0	3
3	Formation of a multilateral partnership in <i>t</i>	0.22	0.15	0	1
4	Number of partnerships formed with new partner in <i>t</i>	1.38	3.11	0	55
5	Formation of a partnership with new partner in <i>t</i>	0.43	0.50	0	1
6	Number of partners from different industries	3.16	2.42	1	22
7	Number of countries represented by partners	2.51	2.11	1	19
8	Number of functions designated to an average partnership	0.91	2.31	0	28
9	Number of partnerships with size advantage formed in <i>t</i>	1.37	3.56	0	68
10	Number equity partnerships entered into in <i>t</i> as the majority partner	0.04	0.23	0	4
11	Number equity partnerships into in <i>t</i> as the minority partner	0.05	0.26	0	4
12	Number of nonequity partnerships formed in <i>t</i>	1.37	3.70	0	62
13	Number of equity partnerships formed in <i>t</i>	0.31	0.87	0	12
14	Cumulative abnormal returns on day [0]	0.000	0.02	-0.22	0.22
15	Cumulative abnormal returns from day [-1] to day [0]	0.001	0.03	-0.22	0.32
16	Cumulative abnormal returns from day [-1] to day [+1]	0.001	0.04	-0.27	0.37
17	Matrix structure	0.05	0.22	0	1
18	Firm size (logged)	3.44	1.11	0	7.65
19	Firm's industry scope	2.46	1.55	1	11
20	Firm's technological scope (logged)	3.30	3.32	0	11.62
21	No patents binary	0.24	0.43	0	1
22	Firm's no. of multilateral partnerships over past 7 years (log)	0.19	0.55	0	3.95
23	Firm's no. of multifunctional partnerships over past 7 years (log)	0.31	0.80	0	4.77
24	Firm's no. of alliances with new partners over past 7 years (log)	0.78	1.55	0	6.16
25	Partners' industries represented over past 7 years (log)	0.61	1.19	0	5.03
26	Firm's geographic scope (log of countries of operation)	2.33	1.26	0	4.70

that span multiple functions, which could indicate a higher tolerance for task complexity. While we cannot pinpoint with certainty the exact reasons for this broader functional scope, qualitative evidence from our interviews with alliance managers suggests that matrix firms involve more internal stakeholders in the alliance deal-making process. This more complex internal decision-making process may contribute to more complex partnership arrangements as the deal develops.

However, matrix firms do not have an insatiable appetite for complexity or relational uncertainty: we find no difference between matrix and nonmatrix firms regarding their engagement in multilateral alliances, and the functional complexity and relational uncertainty to which matrix firms expose themselves is prudently counterbalanced by their preference for equity arrangements, which ensures a more robust formal governance structure and closer alignment of partners' interests. Matrix firm's preference for equity deals may represent an attempt to provide its partnerships with some insulation from its internal structural and relational complexity—a move that could provide more flexibility to alter specific details of the partnership as unanticipated contingencies or conflicts arise. Furthermore, we find that matrix firms are more likely than nonmatrix firms to relinquish *formal* control in partnerships (i.e., by

taking a minority equity stake in equity alliances) and more likely to seize *informal* control by having a size advantage over their partners. While our initial expectation was that matrix managers would disregard all bases of power and instead rely on purely relational mechanisms when pursuing interorganizational collaborations, it appears that matrix managers are attuned to less visible but potent levers of informal influence when dealing with external partners.

The partnership formation tendencies documented in the present study are not likely to indicate matrix actors' categorical overconfidence in their relational abilities. Instead, it seems that actors follow a set of simple heuristics or rules when they form and design collaborative relationships with external partners. This is consistent with Kogut's (2000) proposition that firms may have generative rules that guide interorganizational relationship formation and coordination within those relationships. While Kogut (2000) left the origins of generative rules ambiguous, they are likely based (at least in part) on relevant organizational experience, such as previous alliance engagements. The present study suggests that generative rules may also stem from the general experiences of interpersonal and boundary-crossing collaboration within the firm. Internal experiences can contribute to actors' awareness of their organizations' unspoken

Table 2. ATE and ATET of Matrix Structures on Types of Partnerships Formed

Hypotheses	Dependent variable	N	ATE	Standard error	ATET	Standard error
Baseline	<i>Number of any partnerships formed in year t</i>	3,102	0.386	(0.292)	0.804	(0.699)
Hypothesis 1	<i>Number of multilateral partnerships in year t</i>	3,102	−0.005	(0.010)	0.032	(0.031)
	<i>At least one multilateral partnership in year t</i>	3,102	−0.004	(0.008)	0.032	(0.024)
Hypothesis 2	<i>Number of partnerships with new partners in year t</i>	3,102	0.185	(0.197)	0.361	(0.505)
	<i>At least one partnership with a new partner in year t</i>	3,102	0.047	(0.042)	0.089*	(0.050)
Hypothesis 3	<i>Number of partners from different industries in t</i>	1,426	1.056**	(0.484)	0.928***	(0.339)
	<i>Number of countries represented by partners in t</i>	1,426	0.714*	(0.396)	0.306	(0.252)
	<i>Number of functions designated to an average partnership in t</i>	3,102	−0.043	(0.103)	0.842**	(0.360)
Hypothesis 4	<i>Number of partnerships with size advantage formed in t</i>	3,102	0.389*	(0.210)	0.754	(0.627)
	<i>Number of equity partnerships entered into in t as the majority partner</i>	3,102	0.022	(0.034)	0.051	(0.038)
	<i>Number of equity partnerships entered into in t as the minority partner</i>	3,102	0.046	(0.031)	0.113**	(0.049)
Hypothesis 5	<i>Number of nonequity partnerships formed in t</i>	3,102	0.076	(0.251)	0.285	(0.639)
	<i>Number of equity partnerships formed in t</i>	3,102	0.309***	(0.107)	0.519***	(0.156)

Notes. Robust standard errors in parentheses. ATE, average treatment effect; ATET, average treatment effects on the treated.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

rules and constraints for collaboration and to generalized folk theories about what makes collaboration work and, in turn, influence alliance formation and design choices.

The parallels between patterns of intraorganizational and interorganizational collaboration support the argument that an organization's actors in many cases use the same behavioral logics and scripts for cross-boundary, collaborative work regardless of whether that collaboration involves only internal actors or also includes external partners. One could interpret this as a constraint; indeed, internal patterns of collaboration may be so ingrained and routinized that organizational actors may blindly follow the same patterns, for better or worse, across various isomorphic collaborative contexts. An alternative interpretation might regard the parallelism as evidence of more deliberate and pragmatic behavior. Instead of trying to find a *de novo* mode of collaboration tailored to a specific external partner, an organization's actors simply test whether existing collaborative logics and scripts can be reused. Regardless of the extent of agency in these behaviors, the connection between internal collaborative behaviors and behaviors with external collaborators mirrors similar findings from marketing research that suggest that internal organizational practices and principles provide an attitudinal and behavioral foundation for how employees engage with external customers (Schneider et al. 1998, Masterson 2001). Coupled with this evidence, the findings of the present study could therefore encourage scholars of interorganizational relationships to look for the *intraorganizational* origins of *interorganizational* partnering behavior.

The present paper's second key empirical finding indicates that matrix firms are penalized in the stock market for entering multifunctional, complex alliances.

This finding suggests that investors' inferences about an alliance's contribution to a firm's performance may be shaped systematically by the adopted governance structure of the firm and its corresponding capability to deal with that alliance's specific challenges. The negative investor response makes visible the practical concerns that exist in the market about the optimality of matrix firms' resource allocation choices. It appears, therefore, that investors do not share alliance managers' confidence that matrix structures offer behavioral benefits for managing interorganizational collaboration in multifunctional partnerships. This leads us to advance the concept of the "double-complexity discount," which refers to reduced organizational outcomes incurred for the simultaneous complexity of intra- and interorganizational governance structures.

What are investors' likely specific concerns that provoke the double-complexity discount for multifunctional alliances? Collaboration across multiple functions can entail conflict (driven by diverse function-specific objectives and priorities), knowledge management issues, and coordination. While our empirical data does not allow us to measure these three mechanisms directly—or to identify their differential effect on stock market reactions—the overall pattern of results suggests that conflict and knowledge management may be lesser concerns. Specifically, equity structure and ownership stakes in alliances are closely associated with conflict and power struggles. And yet, we fail to see that markets penalize matrix organizations for favoring nonequity over equity alliances or for taking a minority equity position. Hence, investors do not seem to be overly concerned when matrix firms rely on informal power and conflict management mechanisms. We also find no evidence that the stock market consistently penalizes

Table 3. Effects of Matrix Structures on Abnormal Stock Market Returns to Partnership Formation

Type of partnership	N	ATE				ATET					
		[-1; 0]		[-1; +1]		[-1; 0]		[-1; +1]			
		CAR	Standard error	CAR	Standard error	CAR	Standard error	CAR	Standard error		
Formation of any partnership	4,054	-0.002	(0.002)	-0.003*	(0.002)	-0.001	(0.001)	-0.002	(0.002)	-0.001	(0.001)
Multilateral partnership	71	-0.001	(0.005)	-0.004	(0.011)	0.003	(0.004)	-0.001	(0.004)	0.003	(0.003)
Bilateral partnership	3,983	-0.002	(0.002)	-0.003*	(0.002)	-0.001	(0.001)	-0.002	(0.002)	-0.001	(0.001)
Alliance with new partner	3,326	-0.001	(0.002)	-0.003	(0.002)	-0.001	(0.002)	-0.001	(0.002)	-0.000	(0.002)
Alliance with familiar partner	728	-0.007**	(0.003)	-0.005	(0.003)	-0.004	(0.002)	-0.007**	(0.003)	-0.003	(0.002)
Partners from different industries	2,727	0.003	(0.002)	0.002	(0.003)	0.004*	(0.003)	0.004	(0.005)	0.003	(0.002)
Partners from same industry	1,327	-0.002	(0.003)	0.001	(0.004)	0.000	(0.003)	-0.000	(0.005)	0.000	(0.005)
Foreign partner	1,895	-0.002	(0.002)	-0.003	(0.002)	-0.003	(0.002)	-0.004	(0.003)	-0.003	(0.002)
Same nation partner	2,159	0.001	(0.002)	-0.000	(0.002)	0.001	(0.001)	0.001	(0.002)	-0.001	(0.001)
Multifunctional partnership	308	-0.004	(0.004)	-0.005	(0.005)	-0.006***	(0.002)	-0.013**	(0.006)	-0.019**	(0.004)
Dual-function partnership	268	-0.009***	(0.003)	-0.012***	(0.004)	-0.010***	(0.002)	-0.009***	(0.002)	-0.011**	(0.002)
Single-function partnership	1,541	-0.003	(0.002)	-0.002	(0.003)	-0.002	(0.001)	0.001	(0.007)	0.002	(0.003)
Largest partner	3,529	-0.001	(0.003)	-0.003	(0.003)	-0.001	(0.003)	-0.000	(0.002)	-0.002	(0.001)
Smallest partner	2,730	-0.002	(0.002)	-0.003	(0.002)	-0.001	(0.002)	0.000	(0.002)	0.001	(0.002)
Majority equity partner	84	-0.005	(0.022)	0.004	(0.018)	-0.005	(0.009)	-0.003	(0.009)	-0.016*	(0.009)
Minority equity partner	105	0.013	(0.020)	0.010	(0.017)	0.017	(0.020)	0.012	(0.010)	0.013	(0.010)
Equity partnership	701	-0.001	(0.004)	-0.003	(0.005)	-0.001	(0.005)	0.001	(0.007)	0.002	(0.006)
Nonequity partnership	3,353	-0.002	(0.002)	-0.002	(0.002)	-0.001	(0.001)	-0.000	(0.002)	-0.001	(0.001)

Notes. Robust standard errors in parentheses. ATE, average treatment effect; ATET, average treatment effects on the treated.
 * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

matrix firms for alliances with partners from different industries, in which knowledge management issues are likely to be pronounced. This leaves coordination as the main culprit: investors seem most concerned that the multifunctional partnerships would put significant stress on matrix firms because of the added complexity of coordination, because they engage and interface with the matrix structure most closely.

While unexpected in light of our theoretical argument, the negative stock market reactions resonate with the steady criticism that matrix structures have received. Scholars and practitioners frequently emphasize that decision making in matrix organizations can be slow and onerous, in part because problems that occur at a matrix junction can ripple through functional, geographic, and product units (Burton et al. 2015b). This can also affect alliance-related decisions: prolonged deliberations among internal stakeholders in the matrix firm can limit partners' ability to align effectively across functional domains, especially in complex alliances, and to respond swiftly to unanticipated challenges, thus jeopardizing the partnership's success. In addition, the demands of an internal matrix structure alongside complex interorganizational collaboration likely stretch managers' finite information processing capacity and make them particularly prone to relying on cognitive heuristics. In situations of extreme internal and external complexity, experience often becomes a substitute for broad, deliberate, and methodical analysis of managerial interventions. This can limit both search behavior and managerial practices to well-known alternatives, often leading managers to settle into areas of perceived competence, also known as competency traps (Levitt and March 1988). It can lead managers to overestimate the relatedness of the different domains of knowledge application (i.e., intra- and interorganizational collaboration) and overestimate the transferability of intraorganizational collaborative practices to interorganizational partnerships.

Our results also show that there is no indiscriminate stock market penalty of matrix firms' alliance activities. Specifically, there are favorable stock market returns for cross-industry partnerships and for minority equity positions in partnerships. Here, the market's evaluation of matrix firms' ability to informally negotiate alignment and favorable agreements with diverse constituents appears to match matrix firms' alliance preferences. Further, matrix firms incur no stock market discount compared with nonmatrix firms in dealing with unfamiliar partners and multilateral partnerships. These positive expectations, combined with complexity-related concerns, suggest that investors may appreciate the distinct challenges inherent in different types of partnerships and may have nuanced conceptions of the advantages and disadvantages of different intraorganizational structures for these

types of partnerships. Specifically, investors may regard matrix firms as well prepared to deal with alliances' relational uncertainty and cooperation challenges, but may be overburdened when dealing with task complexity and the resultant coordination problems.

In addition to revealing matrix firms' tendency to form distinct alliances and the market's response to those formed alliances, the present study adds to the currently scant evidence on the factors driving organizations to adopt the matrix organization form. We find a strong positive correlation of firm size and matrix adoption at high levels of the organization (see Online Appendix B). This contrasts with the study by Larson and Gobeli (1987) that found no evidence of firm size predicting matrix adoption for development projects. Although the present research design cannot explain why large firms tend toward matrix structures, findings from our supplemental fieldwork with matrix managers point to large corporations' internal struggles with cross-unit coordination and knowledge dissemination as common motivations for matrix adoption. Furthermore, we find that a firm's technological scope and geographic scope—plausible root causes for the coordination and knowledge-dissemination challenges—increase its likelihood of having a matrix structure. This gives additional credence to theories that suggest that matrix structures are adopted to deal with complex information-processing demands (Galbraith 1974, Burns and Wholey 1993). Importantly, this finding also raises questions about unqualified critiques of matrix firms: if organizations that self-select into matrix designs face significantly more complex information inputs than those that do not, the information overload and slow decision making that is often presented as a consequence of matrix structures may simply be an artifact of the matrix firms' particularly challenging task environments.

Future research could potentially explore more thoroughly the nature of the double-complexity discount for matrix firms engaged in multifunctional alliances. For example, studies using more detailed data on the length and degree of exposure to matrix structures may shed light on whether a firm's learning to operate a matrix can moderate investors' response. Scholars could also assess the validity of investors' assumptions about the effects of intraorganizational structure on alliance performance by combining stock market data with a survey-based assessment of alliance performance. Longitudinal survey data detailing alliance performance could provide additional insights into when and how partners' intraorganizational structures help or hinder collaboration in complex alliances. These lines of inquiry are likely to become especially relevant and promising given the growing complexity of business environments and the concomitant increase in the use of complex intra- and interorganizational structures.

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Endnotes

- ¹ We will also address the potential endogeneity of a firm's decision to use a matrix structure.
- ² In our empirical analyses, we describe our approach to mitigating noise in these predictions.
- ³ We considered using an instrument that would capture cross-industry variation in companies' propensity to adopt a matrix organizational structure. However, data on the firms' internal organizational design is incredibly difficult to collect, and we could not locate any studies that contained such data across industries.
- ⁴ Please refer to Online Appendix C for interpreting the differences in estimates between ATE and ATET.
- ⁵ For robustness, instead of using indicators of a firm's prior experience with complex alliances, we reestimated the models using the firm's general propensity to form alliances among the set of matching variables. Results were similar to those reported here.
- ⁶ Variants using employee counts and profit margins as proxies for partners' relative power produced results identical to those reported in this paper.
- ⁷ The reported pattern of results does not change as we moved the cutoff point up in increments of 1 from 10 to 20 prior alliances.
- ⁸ Our theoretical argument and statistical analyses could be enhanced by examining whether the purported effects of matrix organizations vary depending on the length of time the matrix structure was in place. Although our research design allows us to capture cross-firm variation in matrix and nonmatrix organizational structures, we found it challenging to establish conclusively the year in which the matrix form was adopted. Our expectation, however, is that the effects reported here for alliance formation and outcomes would be amplified for firms that have had longer exposures to a matrix organizational design.

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