Title

Costly Control: An Examination of the Trade-off Between Control Investments and Residual Risk in Interfirm Transactions

Journal

Management Science, 63(7)

ISSN

0025-1909

Authors

Anderson, Shannon W
Dekker, Henri C
Van den Abbeele, Alexandra

Publication Date

2017-07-01

DOI

10.1287/mnsc.2016.2435

Costly control: An examination of the tradeoff between control investments and residual risk in interfirm transactions

Shannon W. Anderson
University of California, Davis
Graduate School of Management
3414 Gallagher Hall; One Shields Avenue; Davis CA 95616
e-mail: swanderson@ucdavis.edu

Henri C. Dekker (*)
Vrije Universiteit Amsterdam
Department of Accounting
De Boelelaan 1105, 1081 HV Amsterdam, The Netherlands
e-mail: h.c.dekker@vu.nl

and

Alexandra Van den Abbeele
Katholieke Universiteit Leuven
Department of Accounting, Finance & Insurance
Naamsestraat 69, 3000 Leuven, Belgium
e-mail: alexandra.vandenabbeele@kuleuven.be

(*) corresponding author. We are grateful to KU Leuven for research funding and for sponsoring the survey. We received many helpful comments from workshop participants at the University of Melbourne, Georgetown University, University of Central Florida, Australian National University, University of New South Wales, VU University Amsterdam and conference participants at the 2011 EIASM Conference on Performance Measurement and Management Control and the 2012 GMARS Conference.

Costly control: An examination of the tradeoff between control investments and residual risk in interfirm transactions

Abstract

Transaction cost economics predicts that investments in management control will enable risky interfirm transactions. Risk is rarely eliminated, because firms trade off costs of management control and expected costs of control loss (together, the "cost of control"). The resultant solution typically comprises a mix of control investments with residual performance and residual relational risks. Transaction cost economics also predicts that the control-residual risk tradeoff will vary with the cost of control. We use survey data on 287 risky information technology transactions to test whether the control-residual risk tradeoff varies predictably with two partnership-specific factors that proxy for variation in the cost of control: prior ties between exchange partners and the criticality of strategic resources to the transaction. The results support the hypotheses, providing novel evidence on tradeoffs that managers make when investing in management controls while also prudently accepting some risks.

Key words: transaction cost economics, resource-based view, incomplete control, prior ties, strategic resources, IT procurement

1. Introduction

Transaction cost economics (TCE) explains firm boundaries and the governance and control structures that sustain risky transactions between firms (Williamson 1985). TCE predicts that if transaction risks are great but not great enough to deter the transaction or to prompt vertical integration, then firms will trade off the costs of management control investments and the expected costs of control loss (collectively termed the "cost of control"). Empirical studies affirm this tradeoff indirectly. They find that "misalignment" of transaction risks and interfirm controls is positively associated with ex post transaction problems and diminished partnership performance (e.g., Anderson and Dekker 2005; Sampson 2004), renegotiation (Reuer and Ariño 2002), and opportunistic behavior (Anderson et al. 2000). The control-residual risk tradeoff rarely eliminates transaction risk. Indeed, the residual risk after deploying interfirm controls typically includes both *performance risks* that accompany complex, interdependent tasks and *relational risks* that arise when firms' self-interest is misaligned (Das and Teng 1996). The empirical literature documents a positive association between transaction risk and the use of interfirm controls (e.g., Geyskens, Steenkamp and Kumar 2006). However, the literature neglects the influence of the cost of control on this association and does not study directly the theorized negative association between interfirm control investments and residual risk.

Prior studies have questioned why firms facing common transaction risks use interfirm controls with differing intensity (Fabrizio 2012; Madhok 2002). We posit that variation in the cost function that moderates the association between transaction risks and control investments provides an important overlooked explanation. Specifically, variation in the cost of control influences the control-residual risk tradeoff. We focus on two partnership-specific factors that proxy for this variation: prior ties between exchange partners and the criticality of strategic resources to the transaction. Theory from TCE and a complementary literature, the resource-based view (RBV) of the firm, suggests mechanisms by which these factors influence the cost of control and the selected mix of controls and residual risk. Das and Teng's (1996) two-part classification of risk is the basis for the hypotheses of the effects of prior ties and strategic resources on the acceptance of residual performance risk and residual relational risk.

Theoretically, prior ties lower the cost of controlling a given transaction risk because partners learn to coordinate effectively, which reduces performance risk, and develop greater trust in each other, which reduces relational risk (Gulati, Lavie and Singh 2009). For a given level of ex ante transaction risk, prior ties indicate a downward shift of the cost of control function that lowers costs without "penalty" of either increased residual performance or relational risks. We test the hypotheses that prior ties attenuate the relation between transaction risk and control investments without inducing a proportional increase in either residual performance risk or residual relational risk.

The RBV extends TCE theory to the special circumstance of transactions that combine partners' scarce and inimitable resources for value-creation. For partnerships requiring strategic resources, the cost of control is altered by firms' increased tolerance for performance risk in activities with high expected returns (Combs and Ketchen 1999). Thus, strategic resources are hypothesized to strengthen the relation between transaction risk and control investments without a proportional decrease in residual performance risk. Transactions with strategic resources typically involve suppliers with favorable reputations, which reduce the cost of control by enhancing partner trust before making control-residual risk tradeoffs (Ireland, Hitt and Vaidyanath 2002). Thus, strategic resources are hypothesized to attenuate the relation between transaction risk and control investments without a proportional increase in residual relational risk.

To test these hypotheses, we use survey data collected from 287 medium-sized Belgian firms that recently engaged in a significant, risky procurement transaction for information technology (IT) products and services. The transactions vary in control investments and residual risks, suggesting that meaningful tradeoffs have occurred. Control costs are not readily measured (Dye 1985; Tirole 1999) and the cost function relating risk to control investment and control loss is unknown. Nonetheless, the common regression model specification for testing TCE that relates transaction risk to the use of management controls suggests an approach for testing the hypotheses. Specifically, the residual of the TCE regression

is often interpreted as control misalignment; however, this interpretation is valid only if all firms face the same costs of control (i.e., if all firms respond identically to risk). With varying costs of control, TCE predicts different tradeoffs. The hypotheses of this paper are theorized based on the expected effects of prior ties and strategic resources on the cost of control and the resultant tradeoffs. In particular, we examine whether the firm invests more or less in control than the TCE regression predicts and whether this difference is associated with residual risk. The tests for whether prior ties and strategic resources alter the cost of control as predicted are operationalized by comparing the regression residual of the TCE regression (i.e., control misalignment) to direct measures of residual performance risk and residual relational risk for transactions with and without these characteristics. The hypotheses that prior ties reduce the cost of control and attenuate the associations of the TCE regression are tested by examining whether control misalignment correlates less strongly with residual performance and relational risk for partners with prior ties. Similar tests are conducted for transactions with low and high levels of strategic resources to test the hypotheses that suppliers with strategic resources reduce the cost of control for relational risk but increase the cost of control for performance risk. The results support the four hypothesized effects.

This study contributes to the extensive TCE literature and to the literature on management controls for interfirm transactions. We test a more complete specification of TCE that includes transaction risks, costs of control, and the tradeoffs that firms make between control investments and residual risk. Although the cost of control is not readily measured, TCE and RBV provide a strong basis for theorizing about how prior ties and strategic resources influence the cost of control and the resultant control-residual risk tradeoff. Measurement innovations, specifically using survey data to measure residual risk directly to disentangle performance and relational risk, facilitate a new approach to examining how cost of control moderates the firm's response to transaction risk. The paper's focus on the cost function that relates ex ante risk to the control-residual risk tradeoff is novel and highlights opportunities for scholars to understand the costs of control investments and control loss.

The paper also contributes evidence that interfirm controls are best explained by treating the RBV motivation for interfirm exchange as a complement rather than alternative to TCE (Argyres and Zenger 2012; Combs and Ketchen 1999; Zajac and Olsen 1993). By using separate measures of residual performance and relational risk, we disentangle two theoretically distinct effects of partnership characteristics on the control-residual risk tradeoff. In the case of prior ties, efficient coordination and competence trust that arise with partner-specific learning mitigate performance risk, and goodwill trust mitigates relational risk. In the case of strategic resources, firms' tolerance for performance risk increases because they anticipate higher returns. These resources also typically involve reputable suppliers, which increases goodwill trust and mitigates relational risk. Gulati et al. (2009, p. 1218) argue that prior ties and

"partner distinctiveness" (similar to the provision of strategic resources) work in tandem to facilitate value creation. We find joint effects of prior ties and strategic resources on the control-residual risk tradeoff, which supports this proposition and highlights how controls support value creation.

2. Literature review and hypothesis development

2.1 Risk and control of interfirm transactions

Transaction cost economics explains firm boundaries and the governance and control structures that accompany risky interfirm transactions as the result of minimizing the sum of production and transaction costs (Williamson 1985). Das and Teng (1996) discriminate between two types of risks for interfirm transactions characterized by uncertainty and information asymmetry: *performance risks* associated with inherently complex tasks that demand a coordinated response and *relational risks* that arise when firms' interests are not aligned. If these risks are neither trivial nor extreme (e.g., which would predict arms-length market transactions and vertical integration, respectively), then TCE predicts that firms will use management controls to mitigate risk and sustain mutually beneficial trade. TCE also predicts that firms will trade off the cost of control to obtain a configuration of controls and residual risk that enables transacting and minimizes the total cost of control (for an illustration of this tradeoff, see online Appendix A1). This tradeoff typically results in intentionally incomplete (in the classical sense of complete contracts anticipating all contingencies) controls and some residual risk, because the investment cost of controlling all contingencies is too great, compared with the cost of control loss. This implies that, for a given transaction, control investment is correlated negatively with residual risk.

Although the influence of control costs is often acknowledged in empirical tests of TCE (e.g., Crocker and Masten 1988; Anderson and Dekker 2005), prior studies typically test a simplified model of the association between transaction characteristics that proxy for risk and the use of management controls, with the assumption that the cost of control is invariant across observations. With greater risk, firms invest more in contracting and use controls more extensively to manage the transaction (e.g., Anderson and Dekker 2005; Arnold et al. 2012; Crocker and Masten 1988; Ryall and Sampson 2009). If the cost function relating a particular risk to the cost of control is invariant across transactions, then one can estimate the relation between risk and control investments without considering residual risk, because the theory predicts a common control-residual risk response for all observations. However, if this assumption is too strong and firms face *different* costs of control for a given transaction risk, then TCE predicts that firms will make *different* control-residual risk tradeoffs. Imprecision in estimating a common coefficient relating transaction risk to controls confounds observation-specific differences in the coefficient (i.e., model misspecification) with measurement error.

It is difficult to ascertain the vulnerability of prior results to the assumption of invariant cost of control. Prior research indicates that firms vary considerably in the effectiveness with which they design

interfirm controls (Kale, Dyer and Singh 2002). Tirole (1999 pp. 772–3) notes that direct measures of contracting costs are illusive: "While there is no arguing that writing down detailed contracts is very costly, we have no good paradigm in which to apprehend such costs." A common (and often criticized) theoretical approach is to model control costs as a fixed cost per contract contingency (Dye 1985). Consequently, studies that document a positive association between transaction risk and controls (e.g., Geyskens, Steenkamp and Kumar 2006) have neglected the possibility of varying cost of control and of risk-bearing as an alternative to or complement of control investments. We have little understanding of why firms facing *common* transaction risks use interfirm controls with differing intensity (Fabrizio 2012). In this paper, we posit that differing costs of control offer a powerful explanation. Specifically, we hypothesize that the control-residual risk tradeoff is influenced by variation in the cost of control that accompanies two partnership-specific factors: prior ties between exchange partners and the criticality of strategic resources to the transaction (for an illustration of the conceptual model, see online Appendix A2). We review theory and evidence for using these factors to proxy for varying costs of control in tests of whether observed control-residual risk tradeoffs correspond with TCE and RBV theory.

2.2 Prior ties between exchange partners

Repeated transactions between exchange partners confer operational efficiencies in contracting and transacting that accrue from learning and trust (Gulati et al. 2009). Prior studies of interfirm control identify the mechanisms by which prior ties between partners reduce the cost of control. Specifically, efficiency in the development of management controls lowers the cost of control investments, and experience-based trust reduces the need for control investments and lowers the cost of control loss (e.g., Dekker 2008, Gulati 1995; Ryall and Sampson 2009). Thus, experienced exchange partners face lower costs of coordination and reduced monitoring requirements for new transactions with one another (Gulati et al. 2009). Gulati (1995) emphasizes the importance of prior ties in aligning partner interests. Even *different* transactions that are embedded in a longstanding relationship create a bond between partners that mitigates risk. Studies of whether prior ties affect interfirm controls hypothesize that transactions are nested in a broader economic and social relationship that exerts influence on all transactions between the partners. Studies consider this influence as dynamic, characterized by learning by doing (Gulati et al. 2009) and as a socially constructed trust between partners with repeated transactions (Gulati 1995; Gulati et al. 2009; Ryall and Sampson 2009).

The moderating effects of prior ties on the relation between transaction characteristics and interfirm controls are distinct for performance risk and relational risk. Performance risk is inherent to any complex task. It is exacerbated in interfirm transactions by the challenge of coordinating actions across firm boundaries (Das and Teng 1996). For given transaction characteristics, transactions between partners with prior ties enjoy reduced performance risk as compared to those between new exchange partners.

Familiar partners understand each other's capabilities, have learned to adapt and coordinate their actions, and have developed "competence trust" (Gulati et al. 2009; Kale et al. 2002; Poppo and Zenger 2002; Ryall and Sampson 2009). Through interaction, firms learn about each other's business practices, routines, capabilities, and interdependencies between their activities. The effect of transaction uncertainties that TCE predicts to be associated with interfirm controls are attenuated between familiar exchange partners (Gulati 1995). Thus, familiar partners are more selective in using controls that fit the needs of the exchange relation, and they are more cost-effective in implementing controls (Gulati et al. 2009; Poppo and Zenger 2002; Ryall and Sampson 2009; Vanneste and Puranam 2010). Gulati et al. (2009) find that learning is a partner-specific experience rather than a general experience of partnering. The benefits of learning within relationships are evident in interfirm control structures (e.g., Vanneste and Puranam 2010) and in improved subsequent transaction performance (e.g., Kale et al. 2002).

Prior ties between exchange partners are also hypothesized to influence relational risk, but for different reasons. Specifically, prior ties is a proxy for "goodwill trust", in which transaction partners set aside narrowly self-interested behavior in the interest of the partnership's continuation (Gulati 1995). Goodwill trust creates an expectation that a partner will act in the long run interests of the relationship, even when doing so does not maximize the partner's profit. Goodwill trust has been described as an alternative to management controls (Gulati 1995). We describe the mechanisms of substitution, positing that prior ties and associated goodwill trust reduce the investment in control for a given transaction risk without a concomitant increase in the expected cost of control loss (i.e., residual relational risk). The interfirm literature provides theoretical and empirical support for the influence of prior ties on reduced control investments that emanate from relationship-specific learning and goodwill trust. It also supports a model in which prior ties attenuate the association between transaction risks and the use of controls (Dekker 2008; Gulati et al. 2009).[1] Consequently, we predict that prior ties lower the cost of control for a given set of transaction risks and manifest in the control-residual risk tradeoff as follows:

H1a: The presence of prior ties between exchange partners attenuates the relation between transaction risk and control investments without inducing a proportional increase in residual performance risk.

H1b: The presence of prior ties between exchange partners attenuates the relation between transaction risk and control investments without inducing a proportional increase in residual relational risk.

2.3 Resource-based motivations for exchange

[1] While prior studies have typically examined direct effects of prior ties on governance and control choices (e.g., Gulati 1995), more recent studies have considered moderating effects, with prior ties affecting the relation between transaction characteristics and these choices (e.g., Dekker 2008). In sensitivity tests of our results, we add direct effects of prior ties and reach similar conclusions.

In contrast to the cost-minimizing logic of TCE, RBV posits that interfirm collaboration is motivated by the pursuit of growth and value creation, which are achieved by combining the unique strategic resources of exchange partners (Argyres and Zenger 2012; Combs and Ketchen 1999). The motivation for value creation through collaboration may be unilateral, where one firm seeks access to partner technology or knowledge, or joint, where firms form strategic alliances (Hitt et al. 2000). Combining arguments from TCE and RBV provides insight into how firms organize transactions with different resource profiles in distinct ways (Combs and Ketchen 1999; Argyres and Zenger 2012).

Prior studies argue that the pursuit of value creation moderates firms' responses to transaction conditions (Combs and Ketchen 1999; Madhok 2002) and alters firms' exposure to performance risk (Das and Teng 1996). Zajac and Olsen (1993) theorize that when interfirm transactions hinge on gaining access to unique resources, the emphasis of control shifts from preventing value appropriation to promoting value creation. Combs and Ketchen (1999) theorize that a firm's need for strategic resources moderates the firm's control response to transaction conditions. With the same conditions, a firm with greater resource needs is willing to bear greater control costs. Madhok (2002) similarly stresses that understanding resource considerations can be imperative for understanding why "there are variations in organizational form under similar transaction characteristics or, alternatively, why different firms organize similar transactions in different ways" (p. 51).

We posit that the heightened performance risk that accompanies a firm's pursuit of value creation shifts the cost function that relates transaction risk to the cost of control upward. That is, a given transaction is associated with greater control investment and greater expected costs of control loss when firms want access to another's strategic resources than otherwise (Combs and Ketchen 1999). Accordingly, greater importance of a supplier's strategic resources to a buyer requires greater control investment than indicated by transaction characteristics alone. For instance, when a buyer contracts with a supplier to develop tailored software with high asset specificity, task interdependence, and uncertainty, the impact of these characteristics on performance risk differs depending on the strategic importance to the buyer. This is because strategic resources alter the transaction's value-creating potential and the buyer's cost of failure. Strategic resources cause buyers to invest more in controls to mitigate risk, but they may also cause them to accept greater residual performance risk (cf. Combs and Ketchen 1999).

The arguments for how strategic resources affect firms' exposure to relational risk are different. Strategic transactions that expose firms to greater performance risk are associated with careful selection of reputable exchange partners who possess critical strategic resources (Hitt et al. 2000; Ireland et al. 2002; Dekker 2008). Supplier reputation provides a signal to buyers about a supplier's resource base and past behavior. This knowledge increases the buyer's goodwill trust and can reduce relational risk (Gulati

1995), effectively shifting the cost of control function downward.[2] In addition to inferences about supplier intentions that are extrapolated from reputation, a buyer's goodwill trust in the supplier relies on "calculative trust" that a supplier will not risk reputational damage with misconduct (e.g., Gulati 1995). Together, these mechanisms support the prediction that strategic resources attenuate the association between transaction risks and control investments without a proportional increase in residual relational risk.[3] Thus, we predict that strategic resources will moderate the control-residual risk tradeoff:

H2a: Importance of the supplier's strategic resources strengthens the relation between transaction risk and control investments without a proportional decrease in residual performance risk.

H2b: Importance of the supplier's strategic resources attenuates the relation between transaction risk and control investments without a proportional increase in residual relational risk.

3. Empirical tests and research setting

3.1 Method of testing

Empirical tests of TCE examine the association between transaction risks and control investments. Hypotheses H1 and H2 predict that partnership characteristics that alter the cost of control will moderate this association. Typically, tests for moderating effects compare nested regression models to determine whether inclusion of a moderator variable improves model fit. However, this approach becomes unwieldy if the regression includes many independent variables (i.e., transaction characteristics that proxy for risk) and moderators (i.e., prior ties and strategic resources) that together yield a multiplicatively expanding set of interaction terms. Even if multicollinearity does not jeopardize interpretation of the estimated coefficients, TCE theory is not developed sufficiently to support distinct hypotheses about the moderators' separate effects on the transaction characteristics that jointly describe transaction risk. To address these concerns, we test for moderating effects using a series of contrasts between the basic TCE regression model that presumes cost invariance and the control-residual risk tradeoffs that are observed for transactions with and without the moderating conditions.

Figure 1 illustrates the testing method. In the TCE literature, the error term in a regression relating control investments to transaction risks is commonly interpreted as control misalignment or management

[2] Supplier reputation may also increase competence trust, partially offsetting the impact on residual performance risk of strategic transactions. However, in transactions with strategic resources, it is unclear that competence in *different* activities is as strong a predictor of performance risk as it is of best effort and relational risk.

[3] Prior studies take a broader conceptualization of management control that includes partner selection as a control (e.g., Dekker 2008). An informed buyer (e.g., one who has engaged in high-quality search and data gathering about potential suppliers) is likely to better apprehend risk and make better decisions. However, search is a relatively unilateral effort of the buyer. This paper focuses on controls that are jointly negotiated by partners in light of partnership characteristics that are present when control-residual risk tradeoffs are made.

error in designing interfirm controls. This interpretation relies on a common cost of control causing firms to respond identically to a given risk. However, if the cost of control varies across observations, then TCE suggests a different interpretation. Underinvestment in controls may indicate a higher cost of control investments, lower cost of control loss may indicate the optimality of accepting greater residual risk, and vice versa. The hypothesized effects of partners' prior ties and the presence of strategic resources on the cost of control can be tested indirectly by comparing the association between control misalignment and measures of residual performance and relational risk for transactions with and without the moderating conditions.

We test the moderating effects of partnership-characteristics that proxy for varying costs of control in interfirm transactions in two stages. The first stage is the conventional TCE estimation model that relates transaction risk to investments in management controls. This stage yields a measure of misalignment between risk and controls. If the cost of controls vary, then the misalignment may proxy as a measure of this variation. The second stage of the analysis compares the correlation between this measure and measures of residual performance and relational risk across subgroups of transactions with and without prior ties and with high and low strategic resources. We test for significance of correlational differences using the r-statistic (Silver et al. 2008). If cost of control varies as predicted with the two moderators, then misalignment will be significantly correlated with residual risk as predicted by the hypotheses. If it does not, then misalignment will be interpreted as managers' errors in control investment, and no difference between the tested subgroups in the correlation with residual risk is expected. Indeed, if errors occur randomly and are unknown to the managers, then the correlation with residual risk should be insignificantly different from zero for all subgroups.

3.2 Research setting

We use survey data collected from medium-sized Belgium firms that recently completed a major IT transaction with an external supplier (Dekker and Van den Abbeele 2010). These IT procurement transactions range from relatively low complexity (e.g., standard software, hardware, equipment, and associated services) with moderate control problems to high complexity (e.g., tailor-made software and design) with potentially large control problems (see online Appendix A3 Panel B). IT transactions provide a rich setting for testing relational and performance risks (e.g., Anderson and Dekker 2005; Batenburg, Raub and Snijders 2003; Poppo and Zenger 2002; Vanneste and Puranam 2010). Anderson and Dekker (2005) describe a high degree of product and service-related failures of IT transactions and relate this to misalignment of contractual controls with transaction characteristics.

In sampling appropriate IT transactions, we closely follow Anderson and Dekker (2005) and Batenburg et al. (2003). We collect information about a range of IT products and services that medium-sized firms buy from IT vendors. Respondents provided information on the firm's most important IT

investment in the past five years. These investments reflect independent transactions to avoid any interdependencies that may affect risk and control choices (e.g., Anderson et al. 2000). The lowest risks are predicted to occur in transactions with combinations of standard hardware, software, and associated equipment in which the buyer relies upon the supplier's knowledge to evaluate needs and configure components. The highest risks are predicted for transactions with highly customized development projects that include relationship-specific investments, high levels of integration, and mutual coordination between the buyer and supplier. Thus, the sampled transactions exclude simple arm's length transactions in which the buyer purchases off-the-shelf components, but include collaborative transactions that vary significantly in relational and performance risks. The presence of strategic resources also varies among the transactions. Tailor-made software, design, and consulting services are necessary investments that have limited impact on value creation for some buyers and critical impact for others. This provides requisite variation to test the hypotheses.

Major IT transactions can be particularly risky for medium-sized firms, which typically lack in-house IT development skills and knowledge. These firms outsource IT selection, system design, and installation.[4] In 242 cases, information was provided about supplier identity. Approximately 79% of the suppliers are local Belgian firms and 21% are international IT firms.[5] Many suppliers provide industry-specific solutions or solutions to support specific business activities (e.g., production scheduling, quality management, inventory and logistics support). For the buyers, IT transactions are characterized by significant information asymmetry with the supplier, because buyers have limited IT resources, knowledge, and capacity for in-house development. A timely response demands collaboration with suppliers to obtain IT services. The challenge lies in balancing interfirm control and residual risk.

3.3 Survey design and administration

The research sample of firms surveyed is drawn from the Amadeus database. Sample firms had to be located in Flanders, with 50 to 250 employees, and with turnover between EUR 10 and EUR 50 million and/or total assets between EUR 10 and EUR 43 million.[6] These criteria resulted in 1,538 medium-sized firms (see online Appendix A3 Panel A for population characteristics). Pre-notification has been shown to yield greater respondent involvement and commitment. Thus, one author and another

[4] Telephone interviews indicated that less than 1% of sampled firms were excluded because they developed IT internally. Although these firms' inability to develop IT in-house may lead to an underrepresentation of risky and complex transactions in the sample, the data show no restricted range on the explanatory variables.

[5] Repeating the analyses for this subsample with an indicator to control for local and international suppliers provides similar results and inferences as reported.

[6] Because the instrument language was Dutch, only firms in the Flanders region were selected. The other criteria ensure that firms are medium-sized (cf. EC recommendation 2003/361).

senior researcher trained and closely supervised a team of six research assistants who contacted all sample firms by telephone over a 10-week period to solicit participation in the study. The assistants followed a structured interview protocol to screen firms for suitability (i.e., having a recent major IT transaction) and to encourage participation. During this process, 275 firms were excluded as unsuitable, and 668 declined to participate.[7] For the 595 firms that agreed to participate, we identified an informant (typically an IT manager responsible for the transaction sampled). This person identified the most important IT investment of the last five years and completed the on-line survey about the focal transaction. To increase the response rate, non-respondents were sent a reminder and received two additional telephone calls. In total, 310 responses were obtained, representing a field response rate of 52% and an overall effective response rate of 25%. The average employment of respondents was 11 years, indicating that they were experienced and knowledgeable. After excluding observations with missing data, the sample contained 287 transactions. To detect and prevent analysis errors, two of the three authors started from the raw data exported directly from the online survey tool and conducted the analyses independently.

The average buyer in the sample has 114 employees and operating revenues of EUR 27.88 million (see online Appendix A3 Panel A). External validity is enhanced by sampling across different industries; the final sample includes utility, manufacturing, construction, and service firms. The differences between the population and sample means on firm size and industry classification are insignificant. Early and late respondents do not differ significantly in firm size, industry participation, transaction attributes, control mechanisms, or respondent age and tenure; thus, there is no indication of response bias.

4. Variable measures

The focal transaction that the respondent selected is the unit of analysis of the survey questions. The survey distinguishes between time periods (i.e., before agreeing on the contract, around the contract, and after the contract). Questions are anchored to a specific time period. In the following sections, we describe how variables are measured using existing scales when available (see also Table 1). Unless stated otherwise, items are measured using a 5-point Likert scale, with 1 representing a low degree and 5 a high degree. For all items, all response categories were used, and the distributions show no important deviations from normality.

4.1 Interfirm control use

[7] Reasons for exclusion included firms that could not be reached (137; e.g., out of business, location change), subsidiaries with no IT investment decisions (98), or firms in the same group as others in the sample with the same respondent (41). In the telephone interview the main reasons cited for not participating were no time (45%), no involvement in IT decisions because of outsourcing (10%), no interest (7%), company policy regarding survey participation (7%), not present (5%), and other reasons, such as firm size or lack of IT investment (27%).

Similar to Dekker and Van den Abbeele (2010), we discriminate between outcome controls and behavior controls. *Outcome control* (OC) is measured with five items about the extent of the buyer's engagement in target setting, evaluating and rewarding outcomes, and providing performance feedback to the supplier. *Behavior control* (BC) is measured with six items about the procedures for achieving goals (not goals achievement itself). The items measure the following buyer behaviors: monitoring supplier's use of procedures, evaluating which procedures are followed, modifying supplier procedures, providing feedback on supplier procedures, participating in cost analysis with the supplier, and requiring supplier reports on methods and practices. Prior research finds that outcome and behavior control are typically used in combination to manage transaction risk. Accordingly, we compute a second-order factor of the two control dimensions to obtain an overall reflection of *MCS extensiveness* (MCS). MCS is the basis for estimating control misalignment, the residual of the TCE regression model, in Section 5.3.

As a validity test, we compare the measures of control use to two other indicators of how firms respond to transaction risks: contract complexity and the buyer's investment in contracting. Contracts are a limited window on interfirm control. Nevertheless, they figure prominently in TCE studies (e.g., Crocker and Masten 1988; Ryall and Sampson 2009), because they are more readily available and their contents can be uniformly codified. Following Anderson and Dekker (2005), the measure of contract complexity is the number of clauses included in the contract from a set of 24 commonly used clauses. Correlations between contract extensiveness and MCS, OC, and BC are positive and significant (r=0.33, r=0.28 and r=0.35, all $p< 0.01$). Clearly, formal contracts are important; however, the modest correlation levels indicate that contracts are but one piece of the control portfolio.

As a second validity test, we compare the three measures of interfirm control use to a measure of investment in control: the logarithm of the number of days spent on contract development and negotiation. Again, contract investments are positively correlated with MCS, OC and BC (r=0.23, r=0.22, and r=0.22; all $p< 0.01$) at a level that indicates similarities and differences between investments in contracting as compared to a broader set of controls. As expected, contract investments are also positively correlated with the measure of contract complexity (r=0.35, $p < 0.01$). Overall, the validity checks support the use of MCS, OC, and BC as measures of the use of a broad set of control practices in interfirm transactions. Additionally, the mean values of days spent on contract development (13.2 days) and on the number of clauses included in the contract (16 clauses) indicate that the sample of transactions cannot be managed easily by complete, standard contracts, supporting the need for careful control design.

4.2 Transaction characteristics that proxy for ex ante risk

We measure four transaction characteristics that proxy for *ex ante* risks: *transaction value, asset specificity*, *uncertainty*, and *task interdependence.* We also measure *supplier competition* to capture supplier power and influence in relation to the specific transaction (Anderson and Dekker 2005).

Transaction value, measured by the original contract price, indicates the size of the transaction and the buyer's direct financial exposure to opportunistic holdup. Larger transactions often take more time to complete, demand more coordination between exchange partners, and are less likely to be repeated in substance for any pair of exchange partners.[8] *Asset specificity* refers to investments in human or physical assets that have little or no value outside the transaction. Asset specificity is measured with three items that assess the magnitude of buyer losses in employee training, data re-entry, and idle production that would accompany product failure. *Uncertainty* is measured with three items that capture the difficulty in specifying and measuring the products and services that are the basis of the exchange. *Task interdependence* creates a need for coordination and mutual adaptation between exchange partners and creates ambiguity about the causes and sources of transaction failure. Two indicators reflect the scope (i.e., number of different components) and the complexity of the components transacted. As in Anderson and Dekker (2005), to measure complexity, we categorize the 18 components that were potentially part of the transaction into five categories that represent increasing levels of interdependence and associated requirements for coordination and interaction. Then we assign the highest score observed for the transaction (see online Appendix A3 Panel B). *Supplier competition* measures the extent to which alternative products and suppliers were available to the buyer at the outset of the transaction. Competition disciplines supplier behavior, reduces supplier power, and may facilitate the design of interfirm controls by providing benchmarks and comparison information about suppliers.

4.3 Residual risk

Residual risk is the risk that remains after implementing interfirm controls, or risk that has not been mitigated by controls. We take a novel approach by measuring residual risk directly. Following Das and Teng (2001), we measure *residual relational risk* as the buyers' assessments of the following four risks at the moment of agreeing on the transaction contract: the supplier may not carry out duties when not monitored, the supplier may not deliver on promises, the supplier may not be fair during the transaction, and the interests of the firm and those of the supplier may conflict. Following Agarwal and Teas (2001), we measure *residual performance risk* as buyers' assessments of the following two risks at the moment of agreeing on the contract: the product or service may not perform as described and the product or service may not work satisfactorily. For all residual risk items, respondents were requested to consider "the information and control mechanisms that were available" and to focus on residual risk, given the firm's investment in interfirm controls.

[8] Of all cases, 26% populate the highest category of transaction value (i.e., more than €100.000). Even if transaction value is modest, for IT transactions the risks of asset specificity can be much greater than direct financial exposure, because of the potential loss of intellectual property and opportunity costs of process interruptions and idle capacity.

We test criterion-related validity of the residual risk measures with two outcome measures. First, respondents reported the extent to which 12 common transaction problems emerged during or after the transaction (cf. Anderson and Dekker 2005). As expected, the correlations of *ex post problems* with residual relational and performance risk are positive and significant (r=0.16 and r=0.20, both $p < 0.01$). Second, respondents rated supplier performance (price, quality, and on-time delivery; composite reliability=0.80) which should be associated with lower residual risk. The correlations with residual relational risk and residual performance risk are indeed negative and significant (r=-0.21 and r=-0.23, both $p < 0.01$). Additional evidence that the measures reflect *residual* (instead of *ex ante*) risk is found in correlations with the transaction characteristics that proxy for ex ante risk that are generally small and in most cases insignificant (see Table 2). This evidence is consistent with firms mitigating risk through control investments.

4.4 Prior ties

Prior ties between partners are measured with an indicator (1=prior ties) of previous exchange before the focal transaction (Dekker 2008; Gulati 1995). Although studies discriminate between learning and trust-building effects of prior ties, the effects are difficult to isolate because most studies use a single measure for the existence and duration of a prior relationship. Vanneste and Puranam (2010) isolate learning effects from trust-building effects by focusing on cross-sectional differences in the potential for learning associated with different contract terms. Directly measuring *both* residual performance risk and residual relational risk provides an alternative for distinguishing the effects. Specifically, learning and the development of competence trust are predicted to mitigate performance risk and building goodwill trust is predicted to mitigate relational risk. Thus, support for H1a is evidence of learning and competence trust, and support for H1b is evidence of the role of goodwill trust.

The potential for prior ties to build goodwill trust is significant in the research setting, where (by design) IT investments are independent of prior investments and buyers can choose among alternative suppliers.[9] We validate the association between *prior ties* and goodwill trust using a survey item that asks respondents to agree or disagree with the statement: "My firm could trust the supplier to keep its promises." The mean score on this item is significantly higher ($p< 0.01$) for firms with prior ties, indicating criterion-related validity. For the subsample with prior ties, the average relationship duration is 6.8 years (median 5 years), indicating that buyers are on average satisfied with prior transactions and that they considered the supplier trustworthy before engaging in this transaction.[10]

[9] Answers to items about the buyer's effort towards comparing suppliers on price, reliability, service, and technological capabilities also support that they generally had choice among multiple suppliers for the transaction.

[10] Satisfaction with the prior relation for firms with prior ties had a mean score of 4.06 on a 5-point Likert scale, with only two buyers reporting negative experiences. This fits the idea that firms prefer partners with whom they

4.5 Strategic resource importance

Measurement of the strategic importance of supplier resources, *strategic resources*, is based on Lui and Ngo (2004). Three items reflect the importance to the buyer of the following supplier resources: the supplier's good reputation, the supplier's rich resources of capital and labor, and the supplier's technical capabilities. These items do not relate to specific transaction characteristics and instead capture more broadly the strategic importance of supplier resources to the buyer.

To test for validity, we first correlate the construct with a survey question about the extent to which the buyer possessed information at the time of contracting about the supplier's reputation for quality, price, and delivery. The positive and significant correlation with *strategic resources* (r=0.24; p< 0.01) is consistent with buyers selecting more reputable suppliers when seeking strategic resources. Next, we correlate the construct with two items that capture whether the buyer possessed publicly available information about supplier attributes and information about their values, integrity, and ethics at the time of supplier selection. The correlations (r=0.27 and r=0.41, respectively; both p<0.01) again indicate that strategic resources are associated with (publicly available) information about supplier reputation and characteristics that promote goodwill trust. Finally, we correlate the construct with measures of the intensity with which the buyer evaluated potential suppliers' technological competencies, reliability, and service. Consistently positive correlations (all p< 0.01) indicate that strategic resources are associated with intensive partner selection. Together, these validity checks support the argument underlying H2b, which posits a weaker association between residual relational risk and control misalignment for transactions where the buyer is motivated by value-creation and engages in transactions with more reputable, trustworthy suppliers.

5. Preliminary Analysis

5.1 Measurement model results

To assess the validity of construct measurement, we use maximum likelihood confirmatory factor analysis in LISREL 8.80.[11] Like prior studies (e.g., Anderson and Dekker 2005), the measurement model treats all constructs as latent variables that are reflected by the measured survey items. Table 1 shows the results. The fit statistics indicate a good fit between the measurement model and the sample data (df=411, χ2=869.92 [p<.01], RMSEA=0.060, SRMR=0.054, CFI=0.95, NNFI=0.94). All factor loadings are

---

share positive past experiences. Mean prior transaction frequency and size were 3.33 and 3.46 on a 5-point Likert scale. Trust in the supplier before the focal transaction had a mean of 3.96, with only one buyer reporting low trust.

[11] We use a combination of fit statistics to evaluate model fit, specifically the standardized root mean residual (SRMR), root mean squared error of approximation (RMSEA), non-normed fit index (NNFI), and comparative fit index (CFI). Recommended cutoff values are 0.06 for RMSEA, 0.08 for SRMR, and 0.95 for NNFI and CFI, with loosened values for combinations of measures (Hu and Bentler 1999).

significant and the standardized loadings are satisfactory. We compare the measurement model to alternatives that (1) specify all risk items as one factor, (2) specify all controls as one factor, (3) specify mixes of independent variables as single factors (e.g., size and asset specificity; complexity and uncertainty), and (4) specify one common factor for all items (i.e., common method bias). Chi-square difference tests and changes in fit statistics indicate that the fit of all alternative models is significantly worse, supporting the reported measurement model and limiting concerns about method bias.[12]

For each multi-item construct, Table 1 reports the composite reliability (CR) and the average variance (AVE) as measures of construct reliability and convergent validity. CR for most constructs exceeds 0.70, and AVE for most constructs exceeds 0.50, providing evidence of satisfactory construct reliability and validity. Finally, for each multi-item construct the square root of the AVE is greater than the correlations with other constructs (reported on the diagonal of Table 2), indicating that these constructs have good discriminating validity (Fornell and Larcker 1981).[13]

5.2 Variable correlations

Pearson correlations reported in Table 2 indicate that multicollinearity poses little concern. Consistent with greater risks prompting greater control investments, transaction characteristics that proxy for risk are positively correlated with the use of interfirm controls. The presence of prior ties is negatively correlated with control use, residual performance, and relational risk. This is consistent with firms obtaining the same (or lower) residual risk at lower cost and with fewer controls when they transact with familiar partners. Strategic resources are correlated positively with control use but negatively with residual risks. Strategic resources are not significantly correlated with proxies for transaction risk. Importantly, this indicates that, consistent with differences between RBV and TCE theory, the motivation for exchange is conceptually different from the attributes of the transaction that make it susceptible to risk. Negative correlations between control use and residual risks are consistent with controls reducing assessed levels of residual risk.[14] The strong correlation between the two types of control, OC and BC, supports aggregation to the higher-order construct, MCS.

[12] Exploratory factor analysis of all items yields the reported factor structure with no significant cross-loadings.

[13] For the second-order MCS construct, CR and AVE are somewhat weaker, and the square root of the AVE is lower than the (logically high) correlations with its sub-dimensions. Because we use these control dimensions as alternative dependent variables, this poses no concerns.

[14] We also estimate a structural equation model to assess the associations (i.e., covariances) between the control and residual risk dimensions, controlling for all transaction characteristics. Model fit is adequate. The analysis shows that while transaction characteristics relate primarily to control design and only weakly to residual risk, the conditional covariances between residual risk and control dimensions remain negative and highly significant. This supports the expectation that given a transaction's risk profile, increased control contributes to decreased risk.

5.3 The measurement of control misalignment

Like prior studies (e.g., Reuer and Ariño 2002; Sampson 2004), we measure control misalignment as the residual from the regression that relates interfirm control and transaction characteristics that proxy for risk (left side of Figure 1). We conduct this analysis for MCS to obtain the primary measure of control misalignment and separately for OC and BC to explore the consistency of results between types of controls. Table 3, Panel A reports the regression coefficient estimates.[15] Consistent with the empirical TCE literature (e.g., Geyskens et al. 2006), transactions with greater transaction value, asset specificity, uncertainty, and task interdependence give rise to more extensive use of controls.[16] For the final measure of control misalignment, the regression residuals are multiplied by negative one (-1.0) to reverse the scale and create a convention in which misalignment measures *underuse* of controls relative to risk. Thus, control misalignment is expected to be positively associated with residual risks. Because positive and negative regression residuals may have different meanings (e.g., over control and under control, relative to risk), online Appendix A4 considers alternative tests that incorporate this difference.

As a validity check of control misalignment, we revisit investments in contracting as measured by the logarithm of days spent on contract development. If control misalignment reflects (in part) managers' calculated investments in control in response to transaction risks, then it should correlate positively with underinvestment in controls. We regress the time invested in contracting on the transaction characteristics, extract the residual, and multiply by negative one (-1.0). Thus greater values reflect greater underinvestment relative to transaction risks. The correlation between control misalignment and underinvestment in contractual control is positive and significant (r=0.12; p<0.05), and this holds for both OC and BC (r=0.11, and r=0.10; both p<0.10). This confirms that the control misalignment measure captures intentional, incomplete responses to transaction risks. It also suggests that costs of control are an omitted moderator in the analysis of control decisions.

5.4 Qualifying the sample: Evidence of tradeoffs between control investments and residual risk

Before testing the research hypotheses, we conduct a preliminary test to confirm that the sample falls within the relevant range for TCE theory in which hybrid organizational forms are sustained by tradeoffs between control investments and residual risk. Results reported in Table 3, Panel B indicate that

[15] Adding industry indicators and firm size as additional control variables to the model provides similar results as reported. The coefficients of these control variables are insignificant.

[16] Although the model R^2 of 13% is modest, this increases to 29% when *prior ties* and *strategic resources* are included as moderating variables. This is comparable to the explanatory power in prior studies in the similar setting of IT transactions by small- to medium-sized firms (e.g., Anderson & Dekker 2005; Vanneste & Puranam 2010). Severe multicollinearity caused by the interaction effects hinders interpretation of the results. The purpose of the Table 3 Panel A analysis is to obtain regression residuals that can be analyzed across the moderating conditions.

control misalignment is positively and significantly associated with both residual performance risk and residual relational risk. This suggests that managers are (at least in part) aware of this misalignment. The results are in line with the TCE prediction that interfirm controls are intentionally incomplete and total costs of control are minimized by balancing control investments and residual risk. Although the correlations in Table 3, Panel B are significantly different from zero, they are also significantly different from one. This is consistent with the observation that the measure of control misalignment used in prior empirical tests of TCE likely confounds intentional and unintentional misalignment with model misspecification.

In the absence of measurement error, the correlation between control misalignment and residual risk indicates the portion of variability of control misalignment that is associated with intentionally incomplete investments in interfirm controls. The remaining variation in control misalignment is associated with unintentional misalignment (e.g., management error in control investments or in the assessment of expected control loss) and with misspecification of the TCE model. We assume that unintentional misalignment is random and uncorrelated with the cost of control.

6. Evidence on the moderating effects of prior ties and strategic resources

6.1 Evidence on the moderating effects of prior ties

Table 4 reports the results of testing H1. Correlations between control misalignment and residual risks are reported for the subsamples with (N=164) and without prior ties (N=123) (Panel A). As predicted, the correlations between control misalignment and residual relational risk and residual performance risk are generally smaller for firms in the subsample with prior ties than for firms in the subsample without prior ties (Panel B). Tests comparing the correlations between the subsamples indicate that the correlation between residual performance risk and control misalignment is significantly larger for the subsample without prior ties (0.38>0.25; $p< 0.01$). This result holds for both OC misalignment (0.37>0.24; $p< 0.01$) and BC misalignment (0.31>0.22; $p< 0.01$). Similarly, the correlation between residual relational risk and control misalignment is significantly larger for the subsample without prior ties (0.25>0.16; $p< 0.01$). The effect is primarily driven by misalignment of BC (0.30>0.15; $p< 0.01$), because the correlation between residual relational risk and OC misalignment does not differ significantly between the subsamples (0.14 versus 0.13; $p> 0.10$).

In support of H1, we conclude that prior ties between exchange partners weaken the association between control misalignment and residual performance and relational risk. As discussed in Section 2.2, the theory linking prior ties to lower cost of control through moderating performance risk focuses on the roles of partner-specific learning and competence trust, whereas the theory for relational risk focuses on prior ties as an indication of goodwill trust. Support for H1a and H1b suggests that both learning and the

development of trust during prior interactions affect the cost of control and mitigate partner concerns about performance risk and relational risk that would otherwise accompany interfirm transactions.[17]

6.2 Evidence on the moderating effects of strategic resource importance

Table 5 reports the results of testing H2. We split the sample using the median score of *strategic resources* to differentiate transactions with low (N=130) and high (N=157) strategic resources.[18] Consistent with H2a, the results of Panels A and B show that the correlation between control misalignment and residual performance risk is smaller for transactions with low strategic resources than for transactions with high strategic resources (0.15<0.35; p<0.01), which holds for both types of controls (0.15<0.36; p<0.01, and 0.13<0.26; p<0.01). Consistent with H2b, the correlation between control misalignment and residual relational risk is significantly greater for transactions with low strategic resources than for transactions with high strategic resources (0.25>0.08; p<0.01), which also holds for both types of controls (0.21>0.02; p<0.01, and 0.26>0.12; p<0.01).

We conclude that strategic resources strengthen the association between control misalignment and residual performance risk and weaken the association between control misalignment and residual relational risk. As discussed in Section 2.3, the theory that relates strategic resources to performance risk focuses on the acceptance of greater risk in the pursuit of value creation. At the same time, the effect with respect to relational risk pivots on the role of supplier reputation that accompanies partnering with suppliers with strategic resources.

6.3 The joint moderating effects of prior ties and strategic resource importance

Table 6 provides results of testing for joint moderating effects of prior ties and strategic resources. The correlations between the three misalignment measures and residual relational and performance risk are reported for four subsamples: the conventional TCE setting (i.e., case 1: no prior ties and low strategic resources, N=62), the conventional TCE setting augmented with prior ties between partners that allow for lower control costs (i.e., case 2: prior ties and low strategic resources, N=68), resource-based motivations for collaborating (i.e., case 3: no prior ties and high strategic resources, N=61), and the setting that combines both prior interactions and resource-based motivations for collaborating (i.e., case 4: prior ties and high strategic resources, N=96). H1a and H2a predict countervailing effects, with prior ties weakening and strategic resources strengthening the association between control misalignment and

[17] We repeat the analysis with an alternative measure that captures the supplier's perceived trustworthiness before the focal transaction. This measure of goodwill trust should affect the assessment of relational risk particularly. Indeed, the results for relational risk remain, whereas the moderating effects on performance risk become insignificant. This is consistent with the difference between trust and learning effects that are confounded in prior ties.

[18] Using the mean score to split the sample provides similar results as reported in Tables 5 and 6.

residual performance risk. In contrast, H1b and H2b predict consistent effects, with both prior ties and strategic resources weakening the association between misalignment and residual relational risk. We examine the stability of the results by comparing the four cases in light of the predictions.

Focusing first on H1a and H1b, we compare cases 1 and 2 for transactions with low strategic resources. The results support hypothesis H1b. For transactions without prior ties, the correlation between control misalignment and residual relational risk is greater than for transactions with prior ties (0.35>0.20; $p< 0.01$). This result holds for misalignment of both OC and BC, (0.31>0.15; $p< 0.01$ and 0.34>0.24; $p< 0.01$). The correlation between residual performance risk (H1a) and control misalignment is also greater for transactions without prior ties than for those with prior ties (0.24>0.14; $p< 0.01$). This result is primarily driven by misalignment of BC (0.28>0.08; $p< 0.01$) and not by misalignment of OC (0.17 versus 0.18; $p> 0.10$).

Continuing with comparisons of transactions with high strategic resources (cases 3 and 4), the results again indicate that prior ties reduce the association between control misalignment and residual risk. For residual performance risk (H1a), the correlation is significantly greater in the subsample without prior ties (0.48>0.29; $p< 0.01$). This holds particularly for misalignment of OC (0.56>0.25; $p< 0.01$), although for misalignment of BC the difference is not significant (0.29 versus 0.27; $p> 0.10$). For residual relational risk (H1b), the difference in correlations between transactions without and with prior ties is significant as well (0.18>0.05; $p< 0.01$). This effect is primarily driven by misalignment of BC (0.29>0.02; $p< 0.01$), but not by misalignment of OC (0.01 versus 0.08).

Focusing on H2a and H2b, we compare transactions with low versus high strategic resources (i.e., case 1 versus case 3 and case 2 versus case 4). Considering first the cases without prior ties, H2a predicts that the correlations between control misalignment and residual performance risk are lower than when strategic resources are high. The results support this expectation (0.24<0.48; $p< 0.01$) and show that the effect is primarily driven by misalignment of OC (0.17<0.56; $p< 0.01$), rather than misalignment of BC (0.28 versus 0.29; $p> 0.10$). For residual relational risk (H2b), we predict the opposite effect that correlations with control misalignment are greater for transactions with low strategic resources. The results also support this expectation (0.35>0.18; $p< 0.01$) and again show this is primarily driven by misalignment of OC (0.31>0.01; $p< 0.01$), not by misalignment of BC (0.34 versus 0.29; $p> 0.10$).

Continuing with the cases with prior ties (case 2 versus case 4), the results again strongly support H2a as control misalignment is more weakly correlated with residual performance risk when strategic resources are low (0.14<0.29; $p< 0.01$). This effect holds for misalignment in both OC and BC (0.18<0.25; $p< 0.01$, and 0.08<0.27; $p< 0.01$). The results are equally strong for H2b. The correlation between control misalignment and residual relational risk is higher when strategic resources are low than when they are high (0.20>0.05; $p< 0.01$). This result also holds for misalignment in both OC and BC

(0.15>0.08; $p< 0.01$, and 0.24>0.02; $p< 0.01$). In online Appendix A4, we present tests that show that the results are robust to alternative tests and specifications.

7. Conclusion

Prior studies provide compelling evidence that interfirm controls are designed in response to transaction risks. A less studied feature of control design is the degree to which the cost of control influences control investments and is thus linked to the alternative of accepting some residual risk. Variation across firms in the cost of control may explain why firms facing common transaction risks use interfirm controls with differing intensity. To examine this explanation, we test whether two partnership-specific characteristics that proxy for variation in the cost of control influence the control-residual risk tradeoff, as evidenced by their moderation of the association between control misalignment and residual risk.

Consistent with prior ties between exchange partners reducing the cost of control, we find that the conventional TCE measure of control misalignment correlates less strongly with residual performance and relational risk when partners have a history of prior ties than when they do not. Further, we find that control misalignment correlates more strongly with residual performance risk and less strongly with residual relational risk when transactions are motivated by buyers seeking to create value through IT investments using suppliers with unique, strategic resources. These findings are consistent with the theory that the cost of control is altered by firms' increased tolerance for performance risk in high expected-return activities and by enhanced partner trust based on supplier reputation that accompanies selection for strategic resources. Joint tests of these moderating effects reinforce these conclusions.

The study contributes an integrated analysis of transaction risks, partnership-specific costs of control, and the buyer's tradeoff when investing in interfirm controls and accepting residual risk. This contribution is made possible by measurement innovations, specifically direct measurement of residual risk and disaggregation of performance and relational risk. Prior studies treat the measure of misalignment derived from the TCE regression between transaction characteristics and interfirm controls as a proxy for residual risk. However, although it includes intentional and unintentional control misalignment that creates residual risk, it also includes errors introduced by any misspecification of the TCE regression model. By measuring residual risk directly, we develop an approach to examining a particular form of misspecification of the TCE regression. Specifically, we show that partnership characteristics moderate the firm's response to transaction risks in a manner consistent with predicted effects of these partnership characteristics on the cost of control. This approach requires researchers to augment their use of archival data (e.g., contracts) with survey data, and it offers a path for developing more complete models of the determinants of interfirm controls.

This paper also contributes more broadly to the literature on embedded relationships and the resource-based view of interfirm exchange. The findings support the argument that the RBV motivation for interfirm transactions is a complement rather than an alternative to TCE (Argyres and Zenger 2012; Combs and Ketchen 1999; Zajac and Olsen 1993). Indeed, the examination of the combined effects of prior ties and strategic resources on interfirm control design provides a test of Gulati et al.'s (2009, p. 1218) proposition that prior ties and "partner distinctiveness" (conceptually related to strategic resources) work together to facilitate value creation. Separate measures of performance and relational risk allow us to disentangle two theoretically distinct effects of prior ties on the risk-control relation: efficient coordination and communication (arising with partner-specific learning and with development of competence trust) that mitigates performance risk and the formation of goodwill trust that mitigates relational risk.

Several limitations temper the interpretation and application of the results. First, although we study a wide range of IT transactions in a variety of industries, the sampling scheme (which focuses on medium-sized buyers of IT projects) limits the generalizability of the findings. Second, survey data are subject to common method bias. The use of objective indicators mitigates, but does not fully eliminate, these concerns. Better measurement could enhance construct validity and identification. Third, we collect in-depth data from buyers about transaction management but do not measure the supplier's cost of control. Suppliers also make control investments and bear residual risk; thus, relating transaction risks to only the buyer's control investments and residual risk is an incomplete picture of the control and residual risks associated with a transaction. Our approach is consistent with prior studies, but capturing data from both sides would allow analysis of both the control-residual risk tradeoff and the apportionment of control investments and risk-bearing between transacting parties. Finally, using data from two time periods, which limits the degree to which measures of residual risk are biased by known outcomes, might allow researchers to test whether higher failure rates implied by greater residual risk outweigh savings related to deliberately incomplete controls.

References

Agarwal, S., and R. K. Teas. 2001. Perceived value: Mediating role of perceived risk. *Journal of Marketing Theory & Practice* 9 (4): 1-14.

Anderson, S. W., and H. C. Dekker. 2005. Management control for market transactions: The relation between transaction characteristics, incomplete contract design and subsequent performance. *Management Science* 51 (12): 1734-1752.

Anderson, S. W., D. Glenn, and K. L. Sedatole. 2000. Sourcing parts of complex products: Evidence on transaction costs, high-powered incentives and ex-post opportunism. *Accounting, Organizations and Society* 25 (8): 723-749.

Argyres, N., and T. Zenger. 2012. Capabilities, transaction costs, and firm boundaries: A dynamic perspective and integration. *Organization Science* 23 (6): 1623-1657.

Arnold, V., T. S. Benford, C. Hampton, and S. G. Sutton. 2012. Enterprise risk management as a strategic governance mechanism in B2B-enabled transnational supply chains. *Journal of Information Systems* 26 (1): 51-76.

Batenburg, R. S., W. Raub, and C. Snijders. 2003. Contacts and contracts: Dyadic embeddedness and the contractual behavior of firms. *Research in the sociology of organizations* 20: 135–188.

Combs, J. G., and D. J. Ketchen, Jr. 1999. Explaining interfirm cooperation and performance: Towards a reconciliation of predictions from the resource-based view and organizational economics. *Strategic Management Journal* 20 (9): 867-888.

Crocker, K. J., and S. E. Masten. 1988. Mitigating contractual hazards: Unilateral options and contract length. *Rand Journal of Economics* 19 (3): 327-343.

Das, T. K., and B.-S. Teng. 1996. Risk types and inter-firm alliance structures. *Journal of Management Studies* 33 (6): 827-843.

Das, T. K., and B.-S. Teng. 2001. A risk perception model of alliance structuring. *Journal of International Management* 7 (1): 1-29.

Dekker, H. C. 2008. Partner selection and governance design in interfirm relationships. *Accounting, Organizations and Society* 33 (7): 915-941.

Dekker, H. C., and A. Van den Abbeele. 2010. Organizational learning and inter-firm control: The effects of partner search and prior exchange experiences. *Organization Science* 21 (6): 1233-1250.

Dye, R. A. 1985. Costly contract contingencies. *International Economic Review* 26 (1): 233-250.

Fabrizio, K. R. 2012. Institutions, capabilities, and contracts: Make or buy in the electric utility industry. *Organization Science* 23 (5): 1264-1281.

Fornell, C., and D. F. Larcker. 1981. Evaluating Structural equation models with unobservable variables and measurement error. *Journal of Marketing Research* 18(1): 39-50.

Geyskens, I., J.-B. E. M. Steenkamp, and N. Kumar. (2006). Make, buy, or ally: A transaction cost theory meta-analysis. *Academy of Management Journal* 49 (3): 519-543.

Gulati, R. 1995. Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances. *Academy of Management Journal* 38 (1): 85-113.

Gulati, R., D. Lavie, and H. Singh. 2009. The nature of partnering experience and the gains from alliances. *Strategic Management Journal* 30 (11): 1213-1233.

Hitt, M. A., M. T. Dacin, E. Levitas, J. L. Arregle, and A. Borza. 2000. Partner selection in emerging and developed market contexts: Resource-based and organizational learning perspectives. *Academy of Management Journal* 43 (3): 449–467.

Hu, L., and P.M. Bentler. 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling* 6 (1): 1-55.

Ireland, R. D., M. A. Hitt, and D. Vaidyanath. 2002. Alliance management as a source of competitive advantage. *Journal of Management* 28 (3): 413-446.

Jaworski, B. J., and D. J. McInnis. 1989. Marketing jobs and management controls. *Journal of Marketing Research* 26 (4): 406-419.

Kale, P., J. H. Dyer, and H. Singh. 2002. Alliance capability, stock market response, and long-term alliance success: The role of the alliance function. *Strategic Management Journal* 23 (8): 747-767.

Lui, S. S., and H.-Y. Ngo. 2004. The role of trust and contractual safeguards on cooperation in non-equity alliances. *Journal of Management* 30 (4): 471-485.

Madhok, A. 2002. Reassessing the fundamentals and beyond: Ronald Coase, the transaction cost and resource-based theories of the firm and the institutional structure of production. *Strategic Management Journal* 23 (6): 747-767.

Poppo, L., and T. R. Zenger. 2002. Do formal contracts and relational governance act as substitutes or complements? *Strategic Management Journal* 23 (8): 707-725.

Reuer, J. J., and A. Ariño. 2002. Contractual renegotiations in strategic alliances. *Journal of Management* 28 (1): 47-68.

Ryall, M. D., and R. C. Sampson. 2009. Formal contracts in the presence of relational enforcement mechanisms: Evidence from technology development contracts. *Management Science* 55 (6): 906-925.

Sampson, R. C. 2004. The cost of misaligned governance in R&D alliances. *Journal of Law, Economics and Organization* 20 (2): 484–526.

Silver, N. C., H. Zaikina, J. B. Hittner, and K. May. 2008. INCOR: A computer program for testing differences among independent correlations. *Molecular Ecology Resources* 8: 763-764.

Tirole, J. 1999. Incomplete contracts: Where do we stand? *Econometrica* 67 (4): 741-781.

Vanneste, B. S., and P. Puranam. 2010. Repeated interactions and contractual detail: Identifying the learning effect. *Organization Science* 21 (1): 186-201.

Williamson, O. E. 1985. *The Economic Institutions of Capitalism*. New York: Free Press.

Zajac, E. J., and C. P. Olsen. 1993. From transaction cost to transactional value analysis: implications for the study of interorganizational strategies. *Journal of Management Studies* 30 (1): 131-145.

Figure 1: Research model and hypotheses

The left portion of the diagram depicts the measurement of misalignment of management controls as the error term in the TCE regression relating transaction risk to control investments. TCE theory predicts that the control-residual risk tradeoff is influenced by the cost of control. The research sample is first qualified as covering transactions with meaningful control-residual risk tradeoffs by testing for a positive association between control misalignment and managers' direct assessments of residual risks. The right half of the diagram depicts testing the theory using two partnership-specific factors that proxy for variation in the cost of control: prior ties between exchange partners and strategic resources.

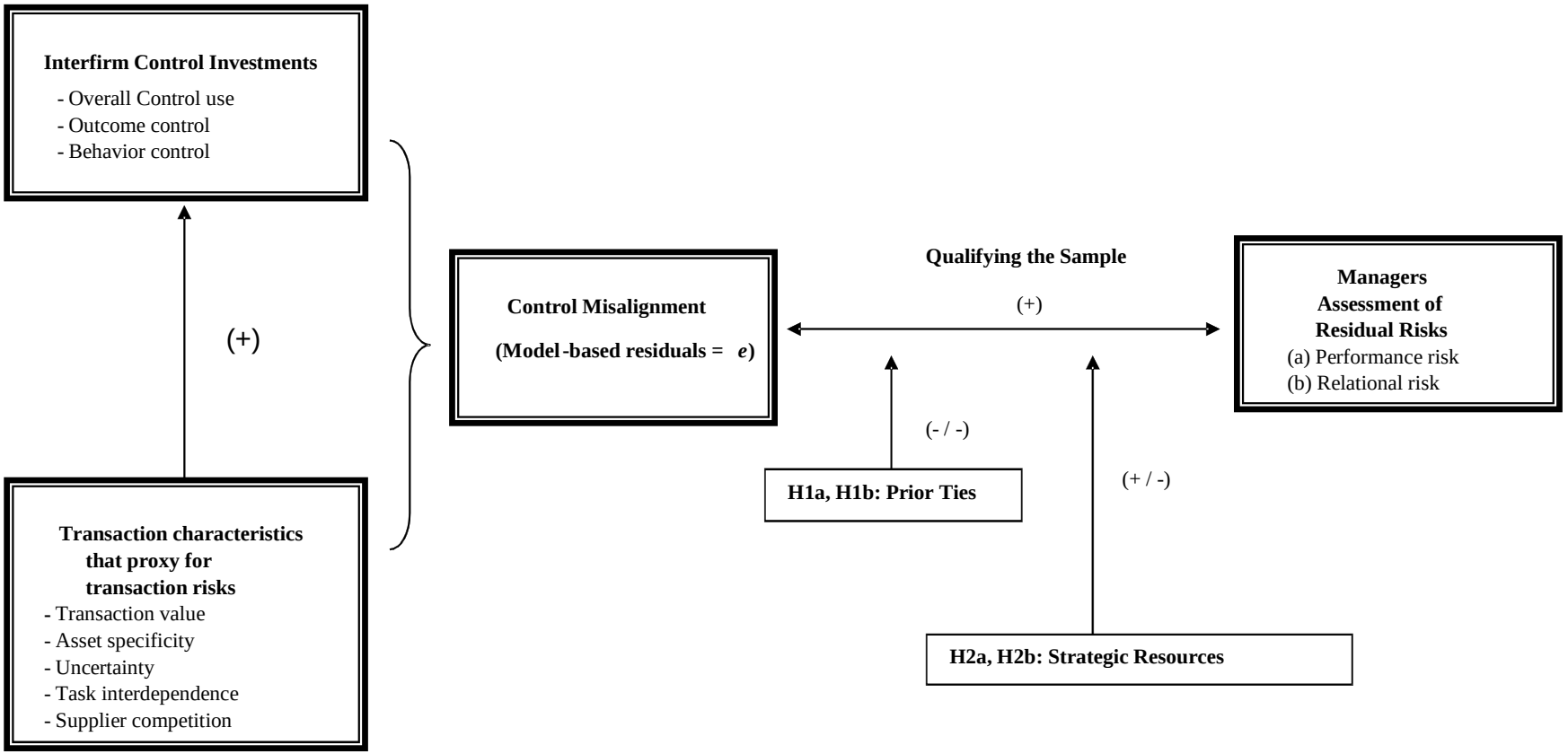

Table 1: Survey items, measurement scales and descriptive statistics (N= 287)[a]

Variable Name - Survey Item(s)	Descriptive statistics Mean	 Sd.	Factor loading
Interfirm control investments			
Outcome control (OC)[b] (Composite Reliability = 0.88 , AVE = 0.60)			
The extent to which the buyer used the following control mechanisms:			
- We established specific performance goals for the supplier (λ=1)	3.13	1.10	0.75
- We monitored the extent to which the supplier realized the performance goals	3.39	1.08	0.86
- If the supplier did not meet performance goals, they were required to explain why	3.37	1.14	0.82
- We provided feedback about the *extent* to which the supplier achieved goals	3.29	1.15	0.83
- The supplier's rewards were based on performance compared to goals	3.06	1.31	0.59
Behavior control (BC)[b] (Composite Reliability = 0.91, AVE = 0.63)			
The extent to which the buyer used the following control mechanisms:			
- We monitored the extent to which the supplier followed established procedures (λ=1)	2.86	1.19	0.83
- We evaluated the procedures the supplier used to accomplish a given task	3.12	1.15	0.85
- We tried to modify the supplier's procedures when desired results were not obtained	2.69	1.23	0.77
- We gave the supplier feedback on the manner in which the supplier accomplished the performance goals	3.02	1.19	0. 81
- We participated in the supplier's cost of activities if they were carried out according to our guidelines	2.90	1.21	0.82
- To evaluate the supplier's methods, the supplier had to report periodically	2.31	1.25	0.66
Overall Control (MCS) (2nd order factor)[b] (Composite Reliability = 0.63, AVE = 0.46)			
- Outcome control (OC)	0.00	1.05	0.68
- Behavior control (BC)	0.00	1.06	0.68
***Ex ante* transaction risk**			
Transaction value			
Initial contract price in Euros; (range 1-5; less than 12,500; 12,500 - 25,000; 25,000 – 50,000; 50,000 - 100,000; more than 100,000)	3.27	1.42	0.89
Asset specificity (Composite Reliability = 0.82, AVE = 0.61)			
If the product failed and had to be replaced, what would have been the loss in time and money (1=*very small*; 5=*very large*) associated with:			
- Training your personnel (λ=1)	2.96	1.35	0.77
- Data re-entry	3.17	1.37	0.88
- Idle production	2.99	1.47	0.67
Uncertainty (Composite Reliability = 0.79, AVE = 0.57)			
- Difficulty assessing the quality of the supplier's product at delivery	2.85	1.16	0.90
- Difficulty comparing different suppliers' products (λ=1)	2.99	1.08	0.83
- Difficulty comparing the price/quality ratio of different suppliers' products	3.00	1.08	0.46
Task interdependence[c] (Composite Reliability = 0.75, AVE = 0.61)			
- Number of components/services bought (from list of 18; range 1-17)	4.45	3.08	0.61
- Product complexity (see Appendix A3, Panel B) (λ=1)	3.67	1.37	0.92
Supplier competition (Composite Reliability = 0.85, AVE = 0.73)			
- Number of potential suppliers at time of purchase (λ=1)	2.62	1.16	0.90
- Number of alternative products at time of purchase	2.49	1.14	0.81

Table 1 (*continued*)	**Mean**	**Sd.**	**Factor loading**
Manager's Assessment of Residual Risks			
Residual relational risk[b] (Composite Reliability = 0.78, AVE = 0.65)			
The extent to which following risks were present (taking into account the information and control mechanisms that were available):			
- The supplier may not carry out duties if he is not monitored (λ=1)	2.03	0.90	0.94
- The supplier may not always deliver on promises	2.05	0.97	0.92
- The supplier may not be fair during the transaction	1.94	0.96	0.93
- The interests of my firm and those of the supplier may conflict	2.11	0.96	0.90
Residual performance risk[b] (Composite Reliability = 0.96, AVE = 0.85)			
The extent to which following risks were present (taking into account the information and control mechanisms that were available):			
- The product or service may not perform as described (λ=1)	2.23	0.76	0.88
- The product or service may not work satisfactorily	2.06	0.86	0.72
Strategic resources			
Strategic resources (Composite Reliability = 0.79, AVE = 0.56)			
The extent to which the following resources were important when selecting this specific supplier:			
- The supplier's good reputation	3.63	0.91	0.80
- The supplier's rich resources of capital and labor (λ=1)	3.31	0.96	0.76
- The supplier's technical capabilities	3.73	0.90	0.68
Prior ties			
Prior ties			
- Had your firm and the supplier transacted before this transaction? (range 0-1)	0.57	0.50	0.89

Fit statistics: df=411, $\chi 2$=869.92 ($p<0.01$), RMSEA=0.060, SRMR=0.054, CFI=0.95, NNFI=0.94. Factor loadings are estimated using confirmatory factor analysis with maximum likelihood estimation in LISREL 8.80.

[a] All items are measured on a 5-point Likert scale (1=*not at all/low degree*; 5=*to a very large extent/ high degree*) unless noted otherwise. Scales of multiple indicator constructs are identified by fixing the loading of the indicator that was expected a priori to best represent the construct at a value of one (λ=1). For transaction value and prior ties we fix a subjectively estimated measurement error at 0.20 times the estimated total variance.

[b] In the survey administration, items relating to outcome and behavior controls were presented in random order.

[c] Items are standardized before the mean computation because of differences in measurement scales.

Table 2: Pearson correlation matrix (N = 287)[a]

		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1.	Residual performance risk	*0.92*											
2.	Residual relational risk	0.31***	*0.81*										
3.	Outcome control (OC)	-0.26***	-0.10*	*0.77*									
4.	Behavior control (BC)	-0.20***	-0.17***	0.68***	*0.79*								
5.	Overall control (MCS)	-0.25***	-0.15**	0.92***	0.92***	*0.68*							
6.	Transaction value	-0.05	-0.06	0.20***	0.27***	0.26***	-						
7.	Asset specificity	0.10*	0.05	0.18***	0.28***	0.25***	0.27***	*0.78*					
8.	Uncertainty	-0.05	0.02	0.24***	0.12**	0.20***	0.23***	0.23***	*0.75*				
9.	Task interdependence	0.08	0.14**	0.10	0.12**	0.12**	0.06	0.09	0.04	*0.78*			
10.	Competition	0.07	-0.01	-0.06	0.09	0.02	-0.15***	0.01	-0.18***	-0.10*	*0.85*		
11.	Prior ties	-0.20***	-0.23***	-0.13**	-0.18***	-0.17***	-0.21***	-0.22***	-0.11*	-0.06	-0.05	-	
12.	Strategic resources	-0.41***	-0.14**	0.27***	0.33***	0.33***	0.03	0.07	0.08	0.04	0.02	0.04	*0.75*

[a] The diagonal provides the square root of the average variance extracted (AVE) for all multi-item constructs (in *italics*); correlations below diagonal. ***, ** and * indicate a *p*-value ≤ 0.01, 0.05 and 0.10 (two-tailed test).

Table 3: Measuring control misalignment and tests to qualify the sample

Panel A:

OLS regression analysis of the association between transaction characteristics that proxy for transaction risks and the use of interfirm controls. (N= 287)

	Interfirm Control		
	MCS	*OC*	*BC*
(Constant)	-0.56	-0.31	-0.89
	-2.94***	-1.34	-4.06***
Transaction value	0.12	0.09	0.17
	3.20***	2.04**	3.82***
Asset specificity	0.14	0.10	0.20
	2.77***	1.70*	3.39***
Uncertainty	0.11	0.18	0.05
	2.13**	3.03***	0.82
Task interdependence	0.10	0.09	0.12
	1.79*	1.38	1.89*
Competition	0.07	0.00	0.14
	1.38	0.05	2.51**
R^2	*0.13*	*0.09*	*0.15*
Adj. R^2	*0.11*	*0.08*	*0.13*

Cell entries are unstandardized coefficients and t-values.
***, **, * indicate a *p* value of ≤ 0.01, 0.05 and 0.10 in a two-tailed test.

Panel B:

Tests to qualify the sample. Correlations between control misalignment and residual performance and relational risks.

	Residual Performance Risk	Residual Relational Risk
MCS misalignment	0.28***	0.17***
OC misalignment	0.28***	0.12**
BC misalignment	0.24***	0.19***

***, **, * indicate a *p* value of ≤ 0.01, 0.05 and 0.10 in a two-tailed test of difference from zero.

Table 4: Tests of the moderating effects of prior ties on the association between control misalignment and residual risks

Panel A:

Correlations between control misalignment and residual performance and relational risks for subsamples with and without prior ties.

Subsamples	Control Misalignment	Residual Performance Risk	Residual Relational Risk
No prior ties	MCS misalignment	0.38***	0.25***
(N = 123)	OC misalignment	0.37***	0.14
	BC misalignment	0.31***	0.30***
Prior ties	MCS misalignment	0.25***	0.16**
(N = 164)	OC misalignment	0.24***	0.13*
	BC misalignment	0.22***	0.15*

***, **, * indicate a *p* value of ≤ 0.01, 0.05 and 0.10 in a two-tailed test of difference from zero.

Panel B:

Tests of H1a and H1b, which provide the expectation that prior ties weaken the association between control misalignment and both residual performance and relational risks.

		Test (p-value)	
Subsamples	Control Misalignment	Residual Performance Risk	Residual Relational Risk
No prior ties > Prior ties	MCS misalignment	0.38 > 0.25 ***	0.25 > 0.16 ***
	OC misalignment	0.37 > 0.24 ***	0.14 > 0.13
	BC misalignment	0.31 > 0.22 ***	0.30 > 0.15 ***

***, **, * indicate a *p* value of ≤ 0.01, 0.05 and 0.10 in a one-tailed test. All significant results remain so under a two-tailed test.

Table 5: Tests of the moderating effects of strategic resource importance on the association between misalignment in management controls and residual risks

Panel A:

Correlations between control misalignment and residual performance and relational risks for subsamples with low and high strategic resources**.**

Subsamples	Control Misalignment	Residual Performance Risk	Residual Relational Risk
Low strategic resources (N = 130)	MCS misalignment	0.15*	0.25***
	OC misalignment	0.15*	0.21**
	BC misalignment	0.13	0.26***
High strategic resources (N = 157)	MCS misalignment	0.35***	0.08
	OC misalignment	0.36***	0.02
	BC misalignment	0.26***	0.12

***, **, * indicate a *p* value of ≤ 0.01, 0.05 and 0.10 in a two-tailed test of difference from zero.

Panel B:

Tests of H2a and H2b, which provide the expectation that strategic resources strengthen the association between control misalignment and residual performance risk and weaken the association between misalignment and relational risk.

		Test (p-value)	
Subsamples	Control Misalignment	Residual Performance Risk	Residual Relational Risk
Low strategic resources < High strategic resources	MCS misalignment	0.15 < 0.35 ***	
	OC misalignment	0.15 < 0.36 ***	
	BC misalignment	0.13 < 0.26 ***	
Low strategic resources > High strategic resources	MCS misalignment		0.25 > 0.08 ***
	OC misalignment		0.21 > 0.02 ***
	BC misalignment		0.26 > 0.12 ***

***, **, * indicate a *p* value of ≤ 0.01, 0.05 and 0.10 in a one-tailed test. All significant results remain so under a two-tailed test.

Table 6: Tests of the joint moderating effects of prior ties and strategic resources on the association between control misalignment and residual risks

Correlations between control misalignment and residual performance and relational risks for subsamples with and without prior ties, and with low and high strategic resources**.**

		No prior ties		Prior ties	
Subsamples	Control Misalignment	Residual Performance Risk	Residual Relational Risk	Residual Performance Risk	Residual Relational Risk
Low strategic resources	MCS mis.	0.24*	0.35***	0.14	0.20*
	OC mis.	0.17	0.31**	0.18	0.15
	BC mis.	0.28**	0.34***	0.08	0.24**
High strategic resources	MCS mis.	0.48***	0.18	0.29***	0.05
	OC mis.	0.56***	0.01	0.25***	0.08
	BC mis.	0.29**	0.29**	0.27***	0.02

Case 1: Low strategic resources, no prior ties (N = 62)
Case 2: Low strategic resources, prior ties (N = 68)
Case 3: High strategic resources, no prior ties (N = 61)
Case 4: High strategic resources, prior ties (N = 96)

Tests of Comparative Predictions from H1a, H1b, H2a and H2b

Case 1 versus Case 2 and Case 3 versus Case 4: H1a and H1b provide the expectation that prior ties weaken the association between control misalignment and residual risk.

		Test (p-value)	
Subsamples No prior ties vs. Prior ties	Control Misalignment	Residual Performance Risk	Residual Relational Risk
Case 1 versus Case 2	MCS misalignment	0.24 > 0.14 ***	0.35 > 0.20 ***
	OC misalignment	0.17 > 0.18	0.31 > 0.15 ***
	BC misalignment	0.28 > 0.08 ***	0.34 > 0.24 ***
Case 3 versus Case 4	MCS misalignment	0.48 > 0.29 ***	0.18 > 0.05 ***
	OC misalignment	0.56 > 0.25 ***	0.01 > 0.08
	BC misalignment	0.29 > 0.27	0.29 > 0.02 ***

***, **, * indicate a *p* value of ≤ 0.01, 0.05 and 0.10 in a one-tailed test. All significant results remain so under a two-tailed test.

Case 1 versus Case 3 and Case 2 versus Case 4: H2a provides the expectation that strategic resources (SR) strengthen the association for performance risk. H2b provides the expectation that strategic resources weaken the association for relational risk.

		Test (p-value)	
Subsamples Low SR vs High SR	Control Misalignment	Residual Performance Risk	Residual Relational Risk
Case 1 versus Case 3	MCS misalignment	0.24 < 0.48 ***	0.35 > 0.18 ***
	OC misalignment	0.17 < 0.56 ***	0.31 > 0.01 ***
	BC misalignment	0.28 < 0.29	0.34 > 0.29
Case 2 versus Case 4	MCS misalignment	0.14 < 0.29 ***	0.20 > 0.05 ***
	OC misalignment	0.18 < 0.25 ***	0.15 > 0.08 ***
	BC misalignment	0.08 < 0.27 ***	0.24 > 0.02 ***

***, **, * indicate a p value of ≤ 0.01, 0.05 and 0.10 in a one-tailed test. All significant results remain so under a two-tailed test.