Contracting to Disincentivize

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Research on collaborative ties in business markets has pre-dominantly investigated how governance forms balance potential gains and transaction hazards within the relationship. We examine how the OEM trades off gains obtained *within* the relationship with its supplier against protection of resources that were developed *outside* such relationship. Adapting the incomplete contracting model by Zanarone, Lo, and Madsen (2016) to the context of industrial markets, we hypothesize that OEMs with more valuable pre-existing resources choose closed-price contracts over open-price contracts to *dis-incentivize* suppliers from over-investing in capabilities that may enable them to appropriate those resources. Consistent with this model, but not with alternative governance theories, our data on component procurement contracts show that: (i) OEMs tend to use closed-price contracts when their pre-existing resources are more valuable, and (ii) the use of closed-price contracts reduces both the supplier's dedicated investment *and* its value-add to the OEM's end product. Our work provides evidence on how parties, cognizant of the "dark side" of entering inter-firm collaborations, strategically balance the conflicting goals of safeguarding pre-existing resources and creating value.

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JEL codes: D23; L14; L22; M21; M31

INTRODUCTION

In business-to-business, distribution channel, and supply chain settings, firms and their partners often enter into agreements that are sources of competitive advantage (e.g., Mowry, Oxley, and Silverman 1996; Jap 1999). For instance, to add value to the end products of original equipment manufacturers (OEMs), component suppliers frequently make dedicated investments that complement the OEM's pre-existing resources and capabilities in customer equity, technology, and channel management (e.g., Moorman and Slotegraaf 1999; Ghosh and John 2009; Lee 2011). A vast body of literature, both theoretical (e.g., Williamson 1979; Grossman and Hart 1986; Wernerfelt 1997) and empirical (e.g., Heide and John 1990; Houston and Johnson 2000; Jap 1999), has focused on how firms use both formal contractual and informal norms to safeguard the dedicated assets of the investing partner from opportunistic behavior by the focal firm. Essentially, by curbing opportunistic instincts, governance mechanisms incentivize the investing party to create value-added benefits for the firm, as well as the overall relationship.

Extant research, however, has largely ignored the potential "dark-side" of such dedicated investments. Specifically, while supplier investments have the potential to add value to its OEM, these investments may themselves enable the supplier (the investing party) to build a capability to exploit and appropriate the OEM's unique resources. In other words, the key governance problem transforms from providing safeguards *to* such supplier investments (the classic transaction cost analysis problem) to constructing safeguards for the OEM *against* such investments.

"Dark-side" motives manifest in different forms in business markets. For instance, in a supplier-OEM context, opportunistic suppliers could utilize their acquired capabilities or knowledge about their clients' internal control systems to shade on quality (Anderson and Jap 2005), exploit spillover from innovations (Dutta and Weiss 1997), or utilize knowledge of their clients' technology, product development, and customer base to sell competing products in the downstream market. The latter has been the experience of many European and Japanese automobile manufacturers in Chinese markets (e.g., the Chinese-version YEMA F-16 is a replica of the Audi A4), and in the computer hardware (see Arruñada and Vázquez 2006 on Lenovo's imitation of its IBM client) and wireless phone sector (see The Economist 2012 on Apple vs. Samsung; Alcacer and Oxley 2014; Wan and Wu 2016). In all these cases, the supplier, after entering into a collaboration with the OEM, uses the expertise gained from its investments and cooperation between the parties to guilefully appropriate some pre-existing endowment or resource possessed by the OEM – either customer-side equity, technology, or design architecture. In essence, in such cooperative ties, the OEM's pre-existing endowments/resources that exist *outside* the focal supplier relationship become entwined in the relationship to the detriment of the OEM. Foreseeing this potential appropriation, the OEMs are likely to adopt mechanisms that limit the supplier's incentive to undertake dedicated investments and therefore trade off appropriation reduction (Wathne and Heide 2000) against value creation.

In this research, we investigate: (i) how firms design governance structures to suppress the appropriation of their unique, pre-existing resources in supplier-side relationships, and (ii) the implications of this governance structure on subsequent outcomes. In particular, we first use the incomplete contracting approach (e.g., Hart and Moore 1988) by adapting Zanarone, Lo, and Madsen's (2016; "ZLM" hereafter) general model on governing knowledge investments in our context of industrial procurement, in which an OEM possessing valuable pre-existing resources seeks a collaboration with a component supplier who may both create value within the relationship (through dedicated investments), as well as appropriate the OEM's pre-existing resources. In particular, we investigate the OEM's choice between a *closed-price contract,* in which the division of trade surplus is determined before the supplier undertakes its dedicated investments, and an *open-*

price contract, in which the two firms negotiate the price, and hence the division of surplus, after the investments are undertaken. The key testable prediction from our formal model is that OEMs possessing high levels of pre-existing resources would find it optimal to choose a closed-price over an open-price contract to safeguard these resources from potential appropriation. This is because under a closed-price contract, the OEM is the residual claimant of any realized surplus; as such, closed-price contracts *dis-incentivize* the supplier from undertaking dedicated investments. This, however, comes at the cost of sacrificing the value-add to the OEM's end-product that a supplier's dedicated investment generates in the relationship.

Second, we take the key testable propositions from our model to proprietary data on 155 procurement contracts for engineered components between OEMs and suppliers in the U.S. Using two-step endogenous switching regressions (Maddala 1983; Wooldridge 2010) to account for the endogeneity of contract choice, our data provide support for our model's predictions. Specifically, we find that: (i) procurement contracts are more likely to have closed-price terms when the OEM's pre-existing resources – measured by the level of equity, or market strength, possessed by the OEM in its customer markets – are high, (ii) the supplier's dedicated investment is lower under closed-price than under open-price contracts, and (iii) that closed-price contracts lead to lower levels of value creation – measured by enhancement of the end-product provided by the relationship – as well as the profitability of the relationship to the OEM. Essentially, choosing closed-price contracts seem to enable the OEM to trade-off the protection of its own pre-existing resources with the value created within the supplier relationship.

This research makes three key contributions to our understanding of designing and managing collaborative supplier ties. First, it illustrates that we need a more expansive scope of analysis to elucidate how the potential for opportunism influences governance design. Whereas classic transaction cost analysis (TCA)-based research has focused on designing governance to safeguard the investing firm's (the supplier) assets from appropriation by the counter-party (the OEM), we shed light on the "reverse" opportunism, i.e., rather than making itself more vulnerable, the investing party could itself act more opportunistically and appropriate rents from the counter-party. This, in turn, should encourage the counter-party, especially one with high levels of pre-existing endowments, to seek governance structures that curb this opportunism. Such governance structures act as a "pre-nuptial" to protect these assets. Second, our incomplete contracting model, and the empirical test of the key predictions, identifies the precise mechanism that links one party's pre-existing resources to governance (price formats), investment (dis-)incentives, and within-relationship value creation. Specifically, we show how the motivation to protect its own pre-existing endowments/resources shapes the OEM's contract choice and the supplier's investment decisions and their impact on the value-add within the relationship. We find that these contracts strategically trade-off the protection of a firm's pre-existing resources against the creation of value by *dis-incentivizing* the suppliers' value-enhancing investments. Notably our findings cannot be explained by other prominent approaches to governance design, including the incomplete contracting theory – ICT (Grossman and Hart 1986; Hart and Moore 1988) or the classic hold-up model of TCA (Williamson 1979). Finally, by incorporating how a firm's unique, value-generating resources systematically influence relationship-level governance and investment decisions, our research builds on recent work (see Wernerfelt 2016 for a different perspective) that suggests an integration of the resource-based view (RBV) and governance theories.

The remainder of the paper is organized as follows. We begin with a brief review of the relevant literature and the contribution of our work relative to this research. We then develop our formal model and generate the key testable predictions. We follow that with our empirical analysis and conclude with implications for research and practice.

LITERATURE REVIEW

Our study integrates different approaches to the theory of the firm – particularly, the RBV on the one hand and TCA and ICT on the other. We begin by briefly reviewing the relevant streams, suggesting why an integrative approach is essential to understanding inter-firm ties, and locate our work and its contributions to these literatures.

Transaction Cost Analysis (TCA) and Incomplete Contracting Theory (ICT)

The standard hold-up model in TCA (e.g., Klein et al. 1978; Williamson 1979) and the related ICT approach (e.g., Grossman and Hart 1986; Hart and Moore 1988) have focused on the role of governance mechanisms to mitigate hazards related to supporting dedicated investments which are assumed to only have productive value *within the relationship*. These theories, however, have not accounted for how particular organizations, with heterogeneous and firm-specific resources – the essence of RBV and marketing strategy – would choose to design inter-firm relationships (Gibbons 2006). This has led to calls for developing a strategic theory of *a* firm to supplant the current theory of *the* firm (Madhok 2002; Foss 2005).

Resource-Based View (RBV)

The RBV emphasizes how firms exploit their unique, heterogeneous, immobile resources in physical, human, and organizational capital to achieve competitive advantages through technology generation, product development, brand and channel management, etc. (e.g., Wernefelt 1984; Barney 1986; Grant 1996). However, since these resources are difficult to imitate and hence appropriate,[1] RBV-based research has not been generally concerned with how and why governance structures, in our case closed- versus open-price contracts, should be discriminatingly aligned with different resource profiles (Williamson 1999).

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[1] More recent studies recognize that the supplier can still acquire capabilities to transfer and appropriate the OEM's pre-existing resources through leakage and spillovers (Harhoff et al. 2003; Bönte 2008).

These limitations of both TCA/ICT and RBV have motivated research to attempt a conceptual and analytical integration by recognizing that firms possessing unique endowments and resources are likely to seek governance structures to mitigate the appropriation hazards in cooperative relationships (e.g., Ghosh and John 1999; ZLM). However, none of the related empirical works have explored the precise mechanisms that link the three key central elements – dedicated investments, governance, and pre-existing resources. For instance, Bensaou and Anderson (1999) explore the determinants of dedicated investments, but ignore the role of both governance and firm-specific resources. Ghosh and John (2005) model the bi-directional causality between contract form and investments; however, they do not consider how firm-specific resources would influence investments, as well as contract/governance choice. Likewise, Lo et al. (2012) investigate the impact of an OEM's pre-existing endowments and resources on contract choice, but treat dedicated investment as exogenous. The latter is clearly insufficient because parties deliberately choose to make value-generating dedicated investments in a relationship (Ghosh and John 1999).

In essence, extant empirical research does not explicitly investigate the interrelationship between the three key constructs – investments, governance, and firm-specific resources. As such, as we demonstrate in our analytical model and data, they do not shed light on how governance forms are designed to balance the protection of a firm's pre-existing resources and the creation of value within the relationship through making specialized, dedicated investments. Thus, the precise contributions of our work to each of these existing streams of research are as follows.

Contributions over TCA

In the standard TCA model of hold-up (Williamson 1979), given bounded rationality and potential for opportunism, the key concern is that contractual arrangements that are initially incomplete and hence negotiable (e.g., open-price contracts) would lead to post-contractual haggling between the parties and dissipate the value of those dedicated investments. Anticipating such value dissipation, the investing party (in our case, the supplier) will under-invest relative to the first-best, efficient level unless provided appropriate safeguards. The efficiency-based logic of TCA would then indicate that this *ex-post* appropriation hazard could be mitigated by using closed-price contracts, as opposed to more incomplete, open-price contracts, because they reduce post-contractual haggling. This reduction in post-contractual haggling constitutes an efficiency improvement (e.g., Crocker and Reynolds 1993), and it increases the supplier's incentive to invest. This TCA-based prediction, however, is opposite to the findings in our model and data that closed-price contracts *reduce*, rather than incentivize, the supplier's dedicated investments.

Contributions over ICT

Like TCA, the ICT literature (e.g., Grossman and Hart 1986; Hart and Moore 1988; Che and Hausch 1999) also argues that *ex post* bargaining triggered by unforeseen contingencies may affect a supplier's incentive to undertake dedicated investments *ex ante*. The key difference between the two is that ICT focuses on the role of bargaining. In particular, if the supplier's dedicated investment is *non-contractible* (i.e., observable, but non-verifiable), the possibility that price would be bargained *ex post* affects the supplier's incentive to invest within the relationship *even if* the bargaining process itself is smooth and frictionless, i.e., even if it does not dissipate the investments' value,[2] because bargaining forces the supplier and the OEM to share the surplus arising from the former's dedicated investment.

[2] Whinston (2003) and Gibbons (2005) argue that the TCA predictions on the effect of governance mechanisms on dedicated investments hold irrespective of whether or not the investments are contractible. For instance, the dedicated investments analyzed in classic TCA studies, such as the co-location of electric utilities and coal mines (Joskow 1987), or of car manufacturing and component manufacturing plants (Klein et al. 1978), are not necessarily non-contractible. The hazards in these setups arise not out of whether or not these investments are contractible, but because the investment's returns can be dissipated *ex post* due to costly haggling. Given that low returns are expected, even if a supplier's investment is perfectly contractible, the buyer will not be prepared to pay the supplier to invest as much as in the ideal "no haggling" scenario.

Che and Hausch (1999) argue that the relative value of an open-price versus closed-price contract in supporting a supplier's dedicated investment depends on the exact nature of such investment. If the supplier's investment was aimed internally at increasing its own production efficiency to create cost savings, ICT would predict that relative to an open-price contract, a closed-price contract would increase the supplier's incentive to invest by making the supplier residual claimant of those cost savings. However, when the supplier's investment aims at enhancing the differentiation of the OEM's end-product – as is in our context – a closed-price contract decreases the supplier's incentive to invest because the supplier is *not* the residual claimant of the value-add from the investment (i.e., the OEM pockets the difference between the value-add and the price paid the supplier). Hence, an open-price contract, by giving the supplier an *ex post* opportunity to re-negotiate and secure some of this differentiation-related value-add,[3] should be relatively more effective than closed-price contracts and, as such, also desirable to the OEM. This, however, contrasts with our model and data which show that parties choose the sub-optimal closed-price contracts even though such contracts reduce the supplier's investments and the associated value add. This is because the OEM, with its own pre-existing customer side equity/resource at stake, has another motivation – to use the closed-price contract to minimize the appropriation of this equity/resources. ICT has ignored this aspect and, as such, its prediction on optimal contract choice is inconsistent with ours.

Furthermore, note that a contract that dis-incentivizes the supplier's investment could be optimal in a richer version of the ICT model, in which *both* the supplier and the OEM invest to enhance the quality of the component – for instance, because the OEM provides dedicated equipment and training to facilitate the supplier's work – but where the OEM's investment is more

[3] Ghosh and John (2005) have argued that differentiation-related value add is more difficult to verify and, hence, more non-contractible than cost reduction.

productive than the supplier's.[4] In that case, a closed-price contract that makes the OEM the residual claimant would increase the OEM's incentive to invest but simultaneously reduce the supplier's incentive and yet, the *net* gain from their joint investments is maximized. In that case, ICT implies that the closed-price contract that dis-incentivizes supplier investments should also *increase* the overall value that the relationship with the supplier adds to the OEM. This prediction of ICT is inconsistent with our model and empirical finding that closed-price contracts *reduce* the OEM's value add from the relationship. In sum, there seems to be no version of the ICT model that would predict our full set of empirical findings.

Contribution to RBV

As noted earlier, RBV has not provided much insight into how different governance structures are aligned with different resource profiles (Lo et al. 2012 and Wernerfelt 2016 are notable exceptions). We demonstrate that highly resourced OEMs use closed-price contracts to prevent appropriation of these resources; however, in doing so, they sacrifice gains within the relationship because closed-price contracts lower both supplier investments and the value add generated within the relationship.

MODEL AND HYPOTHESES

In this section, we adapt the generalized setup in the ZLM model to the specific context of OEMs contracting with component suppliers to develop our testable propositions. In the context of OEM-supplier relations, the model formally illustrates the inter-linkage between the OEM's pre-existing resources, the governance form modeled as the choice between a fixed-price versus an open-price format, and the supplier's investments that add value. In particular, to emphasize the appropriation

[4] Carson (2007) and Ghosh and John (2009) argue that product design and development in engineering-intensive settings require not only creativity, but also specialized technical and engineering capabilities and expertise that are often unique to the suppliers. As such, in many of these settings, it is unlikely that OEM investments can be more productive and add value, compared to supplier investments.

risks posed by the "dark side" of the supplier's investment on the OEM's pre-existing resources, we assume that any loss of value to these OEM's resources resulting from the supplier's opportunism is fully transferred to the supplier. In other words, the supplier's appropriation of the OEM's resources is a "zero-sum game."[5]

In line with the Coase theorem, our parties choose the optimal price format by comparing the joint surplus net of transaction costs (including appropriation) across the two contract forms. To minimize notation and yet capture these key points, we deliberately abstract from other frequently studied determinants of pricing formats, such as environmental uncertainty and technological complexity (e.g., Crocker and Reynolds 1993), and focus instead on the core factors. Nevertheless, in our empirical estimations, we control for these factors covered by conventional TCA.

Consider an OEM (M), who possesses pre-existing resources (of value ω), such as customer-side brand equity and reputation, and product-design capabilities. M seeks to procure a component from a supplier (S) that is to be integrated into M's end-product and sold downstream to M's customers. S can make investments to customize the component to the OEM's end-product and provide additional value to the OEM'S product.

Consistent with industry practice, we organize the timeline of this collaboration as follows (see Figure 1). First, M and S choose the governance – price format (p) – for the component being procured. They either specify the final price upfront (i.e., choose a closed-price contract) or agree to negotiate it *ex post* (i.e., choose an open-price contract). Then, S chooses its level of investment (a) to customize the component to M's product design, technological, and customer needs. The novelty of our model is that S's investment also enables it to learn about M's pre-existing resources and

5 This appropriation of the buyer's pre-existing resources needs not be a zero-sum game. Our qualitative results would hold *a fortiori* if the buyer's loss from appropriation outweighed the supplier's benefit. This would occur if the resources are more productive if used by the buyer or if there are spillover effects to other products sold by the buyer under the same brand name.

appropriate them *ex post*. S then produces the component and the contract terms are executed, unless renegotiated. Finally, M and S obtain their payoffs. M's payoffs, for instance, would include the value add from the customization due to S's investment, but also the potential loss it suffers if S is able to appropriate some of its pre-existing resources.[6]

< INSERT FIGURE 1 ABOUT HERE >

We start with providing the set of assumptions about the functional forms (a through d), the information structure (e through g), the parties' risk neutrality (h), the lack of environmental uncertainty (i), and the availability of additional governance mechanisms (j). Many of these key assumptions are standard in the ICT analytical models (e.g., Hart and Moore, 1988):

a) The investment undertaken by S, $a \geq 0$, generates a value add, $q(a)$, for M. This value add is increasing in the investment ($q_a > 0$) and concave ($q_{aa} < 0$).

b) S's investment cost, for simplicity, equals the investment level, a.

c) To highlight the deleterious nature of appropriation of M's technology or customer-side equity, a share $\beta(a) \in [0,1]$ of the value ω of the OEM's resources is captured by, and fully transferred to, S if it chooses to appropriate them. We assume that the appropriated share is increasing in S's investment ($\beta_a > 0$) and concave ($\beta_{aa} < 0$).

d) Since some positive investment is always induced in our sample of inter-firm ties, we assume that S will choose a positive level of investment in all scenarios analyzed in our model. This is guaranteed by assuming $q(0) = \beta(0) = 0$, and a sufficiently large $q_a(0)$.

e) Consistent with anecdotal evidence from industrial markets (e.g., Hamel 1989; Arruñada and Vázquez 2006) and incomplete contracting models, we assume that S's investment a, the value

[6] For the sake of parsimony, we analyze a simple model with one period and two players. Nonetheless, our results would extend to a model in which many suppliers interact with many OEMs over multiple periods. ZLM work out such an extension to repeated interactions detailed in pp. 2115 - 2117.

of M’s resources ω, M’s value add $q(a)$, S’s private benefit, and M’s loss from appropriation $\beta(a)\omega$, are *observable* to M and S, but *non-verifiable*. Therefore, no contracts contingent on these variables can be enforced by third parties, such as the courts.

f) Consistent with this non-verifiability, we assume that M cannot construct explicit contractual clauses *ex ante* to prevent S’s appropriation of its resources. This is justified by the fact that while non-compete covenants and trade secret provisions may somewhat reduce S’s ability to use its acquired knowledge and capability to compete with M in the short term, they often have limited duration and enforceability (e.g., Liebeskind 1996, 1997; Pooley, 1997; Arora and Merges 2004; Garmaise 2009).

g) Consistent with the standard ICT models, we assume that whether or not M and S trade the component, and the price at which the trade occurs, is verifiable.

h) Following standard convention in ICT, both M and S are assumed to be risk-neutral.

i) While environmental uncertainty does play a role in inter-firm governance, we abstract from it in order to shed light on our key mechanism. Hence, we assume that the environment is deterministic, i.e., there are no market fluctuations or technological shocks. We, however, control for this effect in our empirical models.

j) Social norms (e.g., Macneil 1980; Heide and John 1990) and additional governance mechanisms, such as monitoring, control of decision rights, or hostages as a commitment device (e.g., Williamson 1983; Anderson and Weitz 1992) are also useful to govern inter-firm collaborations. To elucidate our key mechanism, we choose not to explicitly model these governance forms. Nevertheless, we do control for them in our empirical analysis.

Hypotheses

Having laid out our setup and assumptions, we turn to stating our testable predictions and discuss their intuitions. Appendix A1 provides the analytical proofs of these results.

Let a^{FB}be the first-best level of S's investment; that is, a^{FB} is the investment that maximizes the joint surplus, which is the difference between the value add from S's investments and S's investment costs. Note that a^{FB} does not depend on M's pre-existing resources, as the transfer of private benefits to S from M constitutes a zero-sum game. Let the investment levels chosen by S under a closed- versus an open-price contract be given by a^{o} and a^{c}, respectively.

Equations A1 and A2 in the Appendix show that under both the open-price and closed-price contract, the respective supplier investments, a^{o} and a^{c}, are increasing in the value of M's pre-existing resources, ω. This is because S benefits from the appropriation of some of these resources, and these benefits increase with the resource level, ω.

An analysis of Equation A3 in the Web Appendix also shows that S's investments under the open-price contract are higher than under a closed-price contract, i.e., $a^{O} > a^{C}$. The intuition is as follows. Note that under a closed-price contract, the price of the component is fixed *ex ante*. As such, once the component is produced, S cannot demand a re-negotiation of the price and thus cannot capture any more of the value-add from its investment. This, in turn, reduces S's incentive to invest. On the other hand, under an open-price contract, S appropriates a share of the investment's value add by bargaining *ex post* over the price. Anticipating this, S invests more under an open-price contract, and this investment would be larger than that under a closed-price contract, i.e., $a^{O} > a^{C}$. In addition, as a consequence of $a^{O} > a^{C}$, the value-add from incorporating S's component in the OEM's end-product would be higher under an open-price contract than under a closed-price contract, i.e., $q(a^{O}) > q(a^{C})$. The model, hence, delivers the following testable hypotheses:

H_1: *The supplier's investments under an open-price contract would be higher than under a closed-price contract ($a^O > a^C$).*

H_2: *The value add from incorporating S's component into M's end product would be larger under an open-price contract than under a closed-price contract ($q(a^O) > q(a^C)$).*

We now turn to the impact of the level of the OEM's pre-existing resources, ω, on contract choice. Note that under both a closed-price and an open-price contract, S appropriates a share $\beta(a)$ of M's pre-existing resources, ω. This appropriation capability of the supplier is facilitated by its dedicated investment a. Hence, as the level of the OEM's pre-existing resources – and thus S's benefit from appropriation – increases, S becomes more motivated to invest, and its investment eventually exceeds the first-best level. This is because higher level of investments enable S to not only capture part, in our case half, of the actual value add from investment, but also part of ω. In other words, S over-invests relative to what would maximize the joint surplus. This potential loss of its own valuable resources (because S over-invests in the hope of appropriating some of it) makes a farsighted M prefer a price format that dis-incentivizes S from over-investing. A closed-price contract achieves this objective. Hence, we hypothesize that:

H_3: *A closed-price contract is chosen over an open-price contract when the value of M's pre-existing resources (ω) is sufficiently high.*

Taken together, the three hypotheses form a set of an inter-related decision frame. In particular, H_3 suggests that an OEM with high pre-existing resources will choose a closed-price contract over an open-priced contract. This choice of a closed-price contract, however, will lead to lower levels of supplier investments (H_1) and value add within the relationship (H_2). This is the essence of the trade-off faced by the OEM: to protect its pre-existing resources from being appropriated, the OEM chooses a governance form that disincentivizes the supplier from making value-generating investments and leads to lower value add in the relationship.

METHOD

Empirical Context and Data Collection Procedure

We test our hypotheses in the context of industrial OEMs procuring from independent suppliers. We focused on OEMs operating in three major industrial sectors of the U.S. economy: non-electrical machinery (SIC 35), electrical and electronic machinery (SIC 36), and transportation equipment (SIC 37). We use data obtained by Ghosh and John (2005) for their study; hence, we provide only a brief description of the data here. On-site, in-depth interviews with OEM purchasing managers were used to develop a pilot questionnaire that was then administered to purchasing managers at 18 OEMs to verify appropriate wording, response formats, and clarity of the instructions. The final survey was constructed based on their feedback. The unit of analysis is a procurement contract between an OEM and its independent supplier for the supply of a component, or a set of technologically indivisible components integrated into a sub-system, that are physically incorporated into the OEM's end-product. "Independent supplier" in our context means a supplier who is not tied to the OEM by cross-equity holdings; thus, joint ventures and other equity arrangements are excluded from our analysis.

The key informant methodology (Campbell 1955) was utilized to qualify the informants in the study. These individuals were either purchasing managers or directors in industrial OEMs in the three sectors considered in our study: SIC 35, 36, and 37. Multiple telephone calls, five on average, were used to qualify the informant in each firm. These individuals at the OEM firm were then asked to identify their firm's most important product-line and to identify a procurement agreement with an independent component supplier under which their firm purchased an engineered component or sub-system. To encourage participation, these informants were offered a customized report that summarized the relationship profiles in the sample and compared their own relationship with the average profile in the data.

This process yielded a total of 521 informants to whom the questionnaires were mailed. After using reminder cards and follow-up telephone calls and removing responses due to excessive missing data, we obtained a final sample of 161 responses. The sample size is smaller than the original one in Ghosh and John (2005), since we use a larger set of variables and some of those have missing values.[7] Nevertheless, this response rate of almost 30% is similar to the ones obtained in previous studies in similar industrial settings (e.g., Heide and John 1990). Two items that measure informant involvement in, and knowledge of, the procurement relationship were used to assess the quality of the key informants. The involvement question, "How involved are you personally in your business unit's dealings with the supplier?" received an average score of 6.40 (s.d. = 0.66, range = [4, 7]) and the knowledge question, "How knowledgeable are you in general about your firm's dealings with this supplier?" received an average score of 6.38 (s.d. = 0.70, range = [5, 7]) suggesting a reasonably high level of understanding of the business relationship. Finally, we conducted the Armstrong and Overton (1977) non-response test on early versus late responders. We did not detect statistically significant differences on key demographic variables pertaining to the procurement ties, including annual volume of purchase, number of potential suppliers of the focal component, and the proportion of purchase of the component from this supplier.[8]

Measures

We provide below a description of our measures. Table 2 describes the measures and provides the summary statistics. Table 3 shows their pairwise correlations.

<INSERT TABLE 2 & TABLE 3 ABOUT HERE>

[7] The original data set in Ghosh and John (2005) has quite a few missing data on some of the variables uniquely used in our study (e.g., amount of supplier investment and norm of flexibility). By dropping firms that have missing data, our usable sample size decreases from 189 to 161.

[8] We conducted this test at various cut-off levels – responses within 5 weeks versus after 5 weeks, 80% early versus 20% late, and 50% early and 50% late (median) cutoffs. The results were invariant to the cut-off criteria.

Price format: This measure describes the price format used in the focal contract to procure the engineered component or sub-system. Our measure is adapted from Crocker and Reynolds (1993), Ghosh and John (2005), and Lo et al. (2012). Accordingly, we classified *closed-price contracts* as those agreements in which the OEM and the supplier agreed to either a fixed price or a price formula that is adjustable, but only per some objective, verifiable criteria exogenous to an individual firm's actions (e.g., based on inflation in commodity prices, producer price index, etc.). Closed-price contracts thus preclude renegotiation and hence pre-determine the division of trade surplus over the contract period. In contrast, we classified *open-price contracts* as those that either did not specify a price ahead of shipment, or did specify a price but allowed for *negotiated* adjustments *ex post*. Under such open-price contracts, the distribution of trade surplus is determined *ex post*. *Price format* is coded as a binary variable, with closed-price contracts and open-price contracts being assigned a value of 1 and 0, respectively.

OEM's pre-existing endowment/resources: We measured this using a five-item, 7-point Likert scale that measures how much customer value the OEM's end product commands over competing products and end-product market share and margins. Consistent with our theoretical construct, this variable (*OEM market strength*), adapted from Ghosh and John (2005), measures how strong the OEM's product is in terms of price premium, customer perception, and its competitive advantages compared to products offered by its focal competitors. It hence constitutes a measure of the OEM's underlying pre-existing resources and capabilities (Wernerfelt 1984) that a supplier may potentially appropriate.

Supplier's dedicated investment: We asked the purchasing manager of each OEM to rate on a six-item, 7-point scale how extensively the supplier is required to invest in resources, efforts, and training to produce the component that fits the OEM's end-product. This measure, *Supplier's dedicated investment*, denotes a broad spectrum of tangible and intangible investments undertaken by the supplier. Note that a typical OEM and supplier in our sample have already had a long experience (over eight years) collaborating with each other, so the purchasing manager must have a solid understanding of its partner's business, including dedicated investment. The purchasing manager was also asked to estimate the total dollar value of the component supplier's equipment and training expenditures dedicated to facilitate the procurement of the relevant component, choosing from seven rank-ordered intervals (ranging from less than USD10,000 to over $2.5 million). This rank-ordered variable, *Amount of supplier's investment*s, is ordinal and acts as an alternative measure of the supplier's dedicated investment.

Value add to OEM's end product: To measure the value add generated in the relationship, the key informant managers rated on a 7-point Likert scale the perceived profitability of the end-product under the focal component procurement contract, relative to what the OEM might have obtained from some other suppliers (*OEM profitability*). As an alternative measure of value add, respondents also answered a three-item, 7-point Likert scale which measured the extent to which the procured component has helped to differentiate the end product in terms of customer's perceived image, competitive advantage, and sales increase (*End-product enhancement*).

The choice between closed- and open-price terms, the supplier's dedicated investments, and value add to the OEM may also depend on variables that are not explicitly included in our theoretical model. We detail them below.

First, when the OEM's *ex ante* bargaining power (i.e., its bargaining power prior to entering a relationship with a particular supplier) is high, the OEM may seek a closed-price contract to commit the supplier to a fixed and probably low price. To control for this, we use the total *Number of potential suppliers* for the component and additionally construct a measure called *OEM's relative size* – which is the ratio of the OEM's to supplier's dollar sales volume, both in terms of their full portfolio of products. Likewise, the OEM's *ex post* bargaining power might be lower if the supplier cannot be replaced easily. As such, the OEM might be forced to renegotiate despite the presence of a closed-price contract. To control for this, we use *Supplier irreplaceability*, which measures the number of months that the OEM needs to replace the current supplier with a new one. We also control for the importance of the component in the OEM's end product (*Component importance*) in our regressions.

Second, parties might stipulate closed-price contracts only when they perceive that such formal contractual provisions are enforceable by courts. We measured this using a 7-point item *Contract enforceability*, which we expect to be positively correlated with the use of closed-price contracts. Third, several papers adopting the TCA framework have argued that closed prices are costly to renegotiate, and thus less useful in uncertain and complex environments where the terms of trade need to be adapted (Crocker and Reynolds 1993; Bajari and Tadelis 2001; Lo et al. 2012). To control for this, we include *Technological uncertainty* (a three-item scale), which measures the unpredictability of the technology involved in the development of the component, and *Interface complexity* (a single-item scale), which measures the complexity of the interface between the component and the end product.

Fourth, besides the key forces focused on in our study, OEMs may also utilize closed-price terms to incentivize the supplier to keep production costs low. However, using such formal incentive may be less requisite if the parties have dealt with each other in the past or have expectations of the "shadow of the future"; hence, they can rely on self-enforcing, relational agreements to sustain cooperation (e.g., Heide 1994; Corts and Singh 2004). To control for this possibility, we use *Tenure*, which measures the length of the parties' relationship in number of years and *Norm of long-term orientation,* which measures on a four-item, 7-point Likert scale the likelihood of future interactions. Cooperative norms have also been shown to be important in industrial contexts (e.g., Macneil 1980; Heide and John 1990; Heide 1994; Anderson and Weitz

1992). Accordingly, we include *Norm of flexibility*, a four-item, 7-point Likert scale, to measure how flexible the parties are in making adjustments to unforeseen circumstances and requests.

Finally, firms may adopt alternative governance mechanisms in addition to price formats. Our regressions control for three of the commonly used ones: hostages, monitoring rights, and control rights. Regarding hostages, a supplier may be hesitant to commit dedicated investments due to the classic hold-up concern. However, if the OEM also makes a dedicated investment, that commitment itself would mitigate such concerns (Williamson 1983; Anderson and Weitz 1992; Gundlach et al. 1995). To control for this, we use a four-item, 7-point Likert scale to capture the level of *OEM's investment*. To discourage supplier's opportunistic behavior, such as shirking and misrepresentation of information, the OEM would engage in monitoring activities. As such, we use *Monitoring of supplier* to control for the extent of OEM's monitoring across five upstream activities, such as manufacturing processes, quality, and technical specifications. Finally, we include the variable *Control of decision rights* that measures OEM's contractual control over its supplier on six key decisions in their relation, such as delivery schedule, pricing, engineering design, and quality control processes.

Having included a battery of control variables, we believe that our empirical analysis is suitable to isolate the impact of the OEM's pre-existing resources on price formats and the effect of price formats on supplier's investment and value-add for the OEM.

Measure Reliability and Validity

We employed confirmatory factor analysis (CFA) to assess the validity of our multi-item measures. The CFA model included the measures for the OEM's strength in its downstream end-product market, the norm of flexibility, and technological uncertainty. The CFA model suggested an acceptable model fit (χ^2= 221.34, p < .05; NNFI = 0.952; CFI = 0.968; RMSEA = 0.065). Each item loaded significantly (minimum of 0.66) on each of the hypothesized constructs, indicating good convergent validity. In addition, the average variance extracted (AVE) ranged from 0.64 to 0.77, and we found that the AVE for each construct exceeded the squared inter-construct correlations, suggesting good discriminant validity (Fornell and Larcker 1981). Overall, our analysis indicates that our measures and constructs are reliable.

Common Method Variance Analysis

Common method variance is always a concern, especially with perceptual measures in survey data collected from one source. We used a marker variable approach suggested by Lindell and Whitney (2001) to test for common method variance. Specifically, we utilized two different variables: qualification of service provided by the supplier, and monitoring of the supplier's quality control procedures. We then estimated the correlations between all of our relevant constructs and each of these variables, and found that none of the correlations were significant ($p > 0.10$). In addition, we also used the Harmon one-factor test (Harmon 1976) and found that the highest factor accounted for only 9.03% of the total variance explained. Together, these results suggest that common method variance is not a concern in our data.

RESULTS

Estimation Approach

Based on the theoretical predictions discussed above, we test the following empirical hypotheses for a collaborating OEM-supplier dyad: (i) closed-price contracts should be used when the OEM's strength in its downstream product market is high (H_3), and (ii) the supplier's dedicated investment and the value add to the OEM's end product should both be lower under a closed-price contract than under an open-price contract (H_1 and H_2, respectively).

Since contract form is an endogenous decision variable, H_2 and H_3 should not be tested by simply regressing *Supplier's dedicated investment* (or its rank-ordered amounts) and *OEM's profitability* (or *end-product enhancement*) on *Price format*; otherwise, we would obtain biased and inconsistent estimates (Heckman 1978; Lee 1978; Shaver 1998). Since we have full data on the outcome variables under *both* price formats, we use the endogenous-switching regression approach – instead of sample-selection regressions – to correct for the endogeneity and hence examine the effects of contract choice (Maddala 1983; Wooldridge 2010, pp.948-951).[9] In particular, our empirical model is formulated as a system of the following two equations:

(7) $$C_i^* = z_i^{'}\alpha + \gamma\omega_i + v_i$$

is a probit model named the "switching equation," whose dependent variable C_i takes value 1 if $C_i^* > 0$, and value zero otherwise, and

(8) $$y_i^* = x_i^{'}\kappa + \lambda\omega_i + \theta C_i + u_i \,,$$

is an ordered-probit model named the "outcome equation," whose dependent variable y_i takes value $y_i = 1$ if $-\infty < y_i^* < k_1$, $y_i = 2$ if $k_1 < y_i^* < k_2$, …, $y_i = \mathrm{h}$ if $k_\mathrm{h} < y_i^* < \infty$, where $k_1,\ldots, k_\mathrm{h}$ are threshold parameters.

In the contract-choice equation (7), C_i is the dummy variable for price format (closed-price contract = 1; open-price contract = 0), ω_i is a measure of the OEM's resources (measured by OEM strength in its downstream product market), and the vector of regressors z_i includes all other variables. In the outcome equation (8), in which we use the ordered probit regression, y_i is the ordinal variable of suppliers' decisions on dedicated investment and the two collaboration outcomes for the OEM – OEM's profitability and end-product enhancement due to the relationship, and x_i is a vector of regressors that includes all of the variables in z_i from the contract-choice equation, except

[9] If we only had data on the effects of one of the two price formats on supplier's investment or OEM's end-product, then a sample-selection model *cannot* identify the coefficient of price formats in the outcome equation (8). See Miranda and Rabe-Hesketh (2006) and Woodridge (2010, Ch. 19) for detailed discussions.

for the instrumental variable – *Contract enforceability*. α, γ, λ, κ, and θ are coefficients to be estimated.

As discussed previously, enforceability of formal contractual terms is directly related to the choice of price format that is explicit in the contract. However, like typical procurement "boilerplate" contracts in component or sub-system purchases (e.g., Ben-Shahar and White 2006), our informants also indicated that their agreements did not explicitly specify the levels of dedicated investments to be made by the supplier. This is because specifying the production and technological needs to manufacture the component as well as the ongoing nature of such investments make them difficult to contract *ex ante*. Likewise, these contracts almost never specify collaboration outcomes on OEM profitability and end-product enhancement, despite the fact that they may stipulate technical specifications of the component or sub-system being procured. These facts make *Contract enforceability* a valid instrumental variable for *Price format*.[10]

The two error terms, u_i and v_i, are assumed to have a bivariate normal distribution, and the level and statistical significance of their correlation coefficient, ρ, indicates whether price format, C_i, is endogenous in equation (8). We estimate the endogenous switching regression of (7) and (8) jointly by using the full-information maximum-likelihood (FIML) method specified in Miranda and Rabe-Hesketh (2006).

Estimation Results

We present our results on the choice of price format and its effect on supplier's dedicated investment (two measures) in Table 4 and on value add to the OEM (two measures) in Table 5.

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[10] Note that having excluded independent variables in the outcome equations is desirable, but not necessary for identification purposes (Wooldridge 2010, p.806). In unreported regressions, available upon request, we include as a robustness check *Contract enforceability* in both equations (7) and (8), which are thus solely identified by their nonlinear functional form. We obtain results that are qualitatively similar to those presented here.

The first two columns (Model 1) in Table 4 show the switching equation in which we investigate the determinants of price format and its outcome equation, in which we look at how price format affects the level of *Supplier's dedicated investment*. The last two columns (Model 2) replace the dependent variable with the alternative measure, *Amount of supplier's dedicated investment.* These results are obtained from the joint estimation of the two simultaneous equations in the endogenous-switching regression model specified in (7) and (8).

<INSERT TABLE 4 ABOUT HERE>

The Wald statistics and McFadden's pseudo R^2's in Table 4 show good statistical significance and overall fit for our models. Further, the statistics of the endogeneity test on *Price format* reject the null hypothesis that the variable is exogenous. This indicates that adopting the two-stage endogenous-switching regressions to correct for potential bias is appropriate.

<u>First-stage regressions on price formats</u>*:* The results on the determinants of price format (test of H_3) are qualitatively very similar across the two models. Importantly, the contract-form (or switching) equations estimated in columns (1) and (2) provide strong support for H_3, which hypothesizes that the usage of closed prices (versus open prices) increases in the value of OEM resources. In both models, higher *OEM market strength* increases the likelihood that closed-price contracts are adopted (column 1: $\gamma = 0.48$, and column 2: $\gamma = 0.53$).

Concerning the control variables, we find that high *Technological uncertainty* has a negative effect on the usage of closed-price contracts. When technology related to the component is highly unpredictable and rapidly evolving, parties may find it difficult to specify technical features of the component *ex ante* and thus to stipulate the division of the trade surplus in a closed-price contract. *Supplier irreplaceability* also has a negative association with closed-price contracts, albeit its negative coefficient is not statistically significant in column (2). When the OEM is more likely to become dependent on the supplier *ex post*, the component supplier may expect to share more of the future value generated by its investment, and hence may insist on an open-price contract that enables *ex post* bargaining. As one would anticipate, closed-price contracts are more likely when *Contractual enforceability* is high (in both models, α = 0.17).[11] Effects of other control variables on price format are not statistically significant.

Second-stage regressions on supplier's investment*:* The effect of contract choice on supplier investment (test of H_1) is shown in columns (1') and (2'), with *Supplier's dedicated investment* and its amount as their dependent variables, respectively. Our data provide strong support for H_1. Specifically, we find that suppliers make less dedicated investment under closed-price contracts than under open-price contracts (column 1': θ = -1.39, and column 2': θ = -1.72)[12]. This is consistent with our core proposition that closed-price contracts dis-incentivize supplier's investment.

After controlling for this key effect, *OEM market strength* and *OEM's relative size* are both positively correlated with supplier's investment, capturing the scale effect of the OEM. Supplier's investment also increases in the *Interface complexity* between the component and the end product. In column (1') (but not statistically significant in column 2'), supplier's investment decreases with the *Tenure* of the relationship. This implies that as tenure – and probably the accumulated total investment – increases, there is less need for the supplier to incur dedicated investment at the margin. Highly unpredictable technologies would make planning and execution of investments more difficult, which may explain the negative coefficient of *Technological uncertainty*. Furthermore, the fewer is the number of suppliers or the harder it is for the OEM to replace the

[11] With our directional prediction, the coefficient of *Contract enforceability* in column (2) is significant in a one-tailed test (p-values = 0.11).

[12] Results on *Amount of supplier's dedicated investment* in column (2') are robust after further controlling for the dollar size of the focal procurement agreement. For brevity, we do not show the results in the paper, but can provide them to interested readers upon request.

focal supplier, the more the latter invests, although the positive coefficient of *Supplier irreplaceability* is only statistically significant in column (2').

Consistent with TCA and prior studies on distribution channels, governance mechanisms other than the price format also matter for suppliers' investment decisions. As expected, supplier's dedicated investment increases in both cooperative norms of flexibility and long-term orientation. OEM's commitment in terms of its own dedicated investment also facilitates supplier's investment as we see in column (1'). Nonetheless, when the OEM conducts extensive monitoring on the supplier or controls more decision rights in the relationship, the supplier becomes reluctant to invest. Finally, suppliers in SIC 36 have a higher baseline investment than those in SIC 37.

To summarize, results in Table 4 are consistent with the logic of designing contracts to mitigate the potential appropriation of the OEM's pre-existing resources. Specifically, closed-price contracts are used to dis-incentivize supplier's dedicated investment and effort when OEMs have high-value pre-existing resources at stake.[13]

<INSERT TABLE 5 ABOUT HERE>

Second-stage regressions on value added: Table 5 presents the results for the effect of price format on the value added by the supplier relationship to the OEM (test of H_2). Here, *OEM's profitability* and *End-product enhancement* are the dependent variables in the outcome equations. Again, the two sets of results are qualitatively similar and consistent with our core predictions. The statistics in Table 5 again show that: (i) price format cannot be treated as exogenous, and (ii)

[13] One could argue that when the OEM has high ex ante bargaining power, it may insist on a closed-price contract to prevent potential hold up by the supplier ex post, and that as a result, the latter's investment will be lower. This implies that in a regression estimating the likelihood of using closed price contracts, the interaction between the OEM's ex ante bargaining power and the supplier's ex post hold up likelihood should have a positive coefficient . Using OEM's market strength and relative size as measures of OEM ex ante bargaining power and supplier's irreplaceability, and level of component customization and technological uncertainty as proxies for supplier's hold up potential, we test this alternative bargaining power hypothesis. The constructed interaction terms in our regressions do not find support. We thank an anonymous referee for encouraging us to test this hypothesis and will provide these results to interested readers upon resquest.

goodness of fit and model significance are excellent in both sets of regressions. The first-stage switching regressions on the determinants of price format show almost identical results to those obtained in the first stage, as shown in Table 4.

The outcome equations in both models in Table 5 provide strong support for H_2 (θ = -1.41 in columns 1' and θ = -1.47 in column 2'): closed-price contracts generate lower value add under both measures of the dependent variable. This result, along with those seen in Table 4 suggest that closed-price contracts curb supplier investment, at the cost of sacrificing value creation within the relationship but enable the OEM to protect their pre-existing resources that could be potentially be subject to guileful behavior by the supplier.[14]

Turning to the control variables, similar to the results on supplier's investment in columns (1') and (2') in Table 4, we find that predictable technology (reverse of technological uncertainty), OEM's relative size, and the ease of selecting or replacing the supplier all lead to higher value add to the OEM. The OEM's value add also increases in *Component importance*. A more complex component interface – and hence a more premium or sophisticated end-product – gives rise to higher OEM profitability, but is less likely to generate end-product enhancement. Moreover, an additional year in dealing with the supplier increases the OEM's profitability, but decreases its end-product enhancement. Although the latter result might be somewhat surprising, it corroborates with the negative marginal effect of tenure on supplier's dedicated investment (see column 1' in Table 4 and related discussion above). More flexible norms seem to facilitate cooperation and thus end-

[14] Our analytical model also assumes that the supplier's dedicated investment contributes to the value add of the component to the OEM's end product. Such forms of value-enhancement are indeed the *sine qua non* for undertaking dedicated investment. Incorporating this effect in our econometric specification would require a three-stage regression setup with two additional instrumental variables, one for *Supplier's dedicated investment* and one for *Amount of supplier's investment*. Unfortunately, our data set does not have measures that would enable us to capture this. Nonetheless, the pairwise coefficients of correlation in Table 3 among supplier investments and its amount and the two collaborative outcomes are all positive, with magnitudes ranging from 0.22 to 0.68 and statistically significant at the 1% level.

product improvement. However, being too flexible to changes and adjustments and OEMs retaining tight control rights may increase its overall operation costs and thus decrease its profitability. Finally, OEM’s dedicated investment in the relationship and close monitoring of the supplier are both beneficial to end-product value.

Remarks

As pointed out earlier, we do not have a direct measure of the actual harm caused to the OEM’s pre-existing resources due to the supplier’s appropriation potential. Hence, we cannot offer direct evidence that closed-price contracts are being used to reduce the supplier’s appropriation of the OEM’s resources. However, our results on both reduced investment and value-add under a closed-price contract offer robust indirect evidence of this underlying mechanism which, as pointed out in the literature review section, cannot be reconciled with predictions from the conventional TCA or ICT models. We thus conclude that our empirical evidence strongly supports the notion that contractual price terms are also used to safeguard OEMs’ pre-existing resources which, however, comes at the cost of reducing the suppliers’ dedicated investment and value creation within OEM-supplier collaborations. This trade-off between strategic (to protect one’s resources) versus efficiency (to enhance value) considerations is consistent with the integrative approach emphasizing the “double-edged sword” nature of dedicated investments, as pointed out in particular by ZLM and in general by the Governance Value Analysis model of Ghosh and John (1999).

DISCUSSION

Theoretical frameworks like TCA and ICT, and the empirical work based on them, have predominantly focused on explicating the efficient design of governance forms to mitigate contractual hazards (e.g., safeguarding specific investments) that arise *within* a relationship. The frameworks have been criticized, however, for not taking into consideration how firm-specific motivation and resources would differentially impact governance design (Ghosh and John 1999;

Madhok 2002) and has led to calls for a *strategic* theory of the firm (e.g., Foss 2005) that integrates the firm-specific resource-based (RBV) with the comparative governance perspective of TCA/ICT to provide a better understanding of value-generating governance forms.

This paper addresses this core issue in the context of industrial sourcing of engineered components where the buyer (OEM) possesses pre-existing resources and capabilities while the seller (component supplier) makes dedicated investments and investigates the role of contracts, in particular their price formats. We adapt the incomplete contracting model from ZLM, where we assume that the seller's dedicated investments might not only serve the productive purpose of generating value within the relationship, but also serve the opportunistic purpose of expropriating the buyer's pre-existing resources. If these buyer's resources are valuable, the seller may have an incentive to over-invest *ex ante* so that the capabilities acquired in the investment process may enable it to appropriate the buyer's resources *ex post*. This is in alignment with Klein's (1996) argument that in non-contractible relational exchanges, all undivided economic rents – regardless of whether they are transaction-specific or firm-specific – become subject to appropriation unless farsighted parties install protective measures to price out these assets. Our model reveals that a contract that fixes the price *ex ante* reduces the seller's incentives to both over-invest and appropriate the buyer's pre-existing resources. However, because of the lower level of supplier's dedicated investment, this advantage of a closed-price contract comes at the cost of reducing the value creation for the OEM. The strategic calculus between value protection and value creation is hence obtained. These predictions were tested and supported by our data on 161 component procurement agreements. More generally, our work is consistent with the implications of "dark-side" motives, in which OEMs design their contracts to lower the exposure of their pre-existing resources in collaborative ties (Ghosh and John 1999).

In terms of managerial implications, our results provide guidance on how OEMs that bring valuable resources, such as proprietary technologies, product development and design skills, and a strong downstream customer base (through strong brands), into their contractual relationships with component suppliers should manage such ties. Borrowing from Gilson's (1984) idea of "governance value engineers", we suggest that OEM managers should be careful about contract-format choices when they structure such relationships. Specifically, we suggest that these contracts should balance: (a) their expected gains from the value-added investments and customization within the relationship with (b) their expected losses borne out of exposing their pre-existing endowments, resources, and capabilities to potentially opportunistic actions on the part of the supplier. Indeed, if the potential harm from such appropriation is prohibitive, the party with pre-existing resources at stake could completely forsake cooperative ties and opt for pure market exchange with a multitude of vendors supplying commoditized components. Alternatively, managers could decide to develop and produce value-added components internally to minimize such *ex post* problems.

Our results also offer advice to suppliers. In particular, how could a component supplier persuade an OEM, especially one with a large pre-existing resource profile, to enter into an open-price contract that enhances dedicated investments and leads to value creation? Our data show that promoting a long-term orientation and being flexible to unforeseen circumstances and the OEM's demands would help the supplier to build a reputation for being relationally-oriented. Our results also show that making it more difficult for the OEM to replace the supplier could also assist in the use of more flexible, open-price contracts. This implies that by committing to the relationship, and hence making it difficult for the OEMs to substitute with an alternative vendor, the focal supplier may be able to "soften" the contractual terms.

We conclude by discussing some limitations of our study and related implications for future work. First, our unit of analysis is a contract, and we use contract-level data obtained via a survey instrument. Even though necessary precautions were undertaken during the collection of the data, and even though our measure validation results suggest that common method bias and the problems resulting from it are not significant in our data, it would be useful if future studies use direct, transactional data to study similar effects. Second, our hypotheses generate predictions based on the underlying assumption of potentially *ex post* appropriation by the supplier; however, we do not have data measuring such appropriation. To comprehensively test this part of our theory, future studies would have to combine information on value creation within a relationship and longer-term appropriations external to the relationship (e.g., Alcacer and Oxley 2014). Third, our analysis focuses on the indirect role of price terms – via dis-incentivizing investment – in safeguarding the OEM buyers' pre-existing resources. This need not be the only form of safeguard that contracting parties could utilize. For instance, depending on the institutional context, companies could also use other explicit clauses, such as exclusive contracts and intellectual property laws, to serve a similar purpose. It would be fruitful to investigate their roles, both separately from and interactively with the price formats, in such contexts. Lastly, in many other industrial contexts, such as automobile and jet manufacturing, and information technology service and solutions markets, both the OEM and its key suppliers may jointly invest to develop their product offerings to end customers. It is typical also for both parties to bring pre-existing resources and capabilities into their relations – for instance, proprietary, state-of-the-art technology in a specific domain by the supplier and an integrative, value-enhancing architecture based on in-depth customer knowledge by the OEM. Future theoretical and empirical investigations on more complex alliances will need to provide insights on how firms design and manage their governance arrangements in such "two-sided" scenarios. Finally, by incorporating RBV elements (e.g., the role of value-generating resources) into the comparative governance design logic of TCA/ICT, our research responds to calls for an expanded scope of analysis on inter-firm relationships (Foss 2005). Our focus here was on how safeguarding motives would affect contract design; however, the need for adaptation – another central mechanism in inter-firm relationships – could constitute another line of productive inquiry for integrating RBV and TCA/ICT. Wernerfelt's (2016) analysis on how adaptation and specialization actually form the foundation of RBV offers an intriguing glimpse of this inter-play. We hope that future research pursues this line of inquiry.

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Figure 1. Timeline of events.

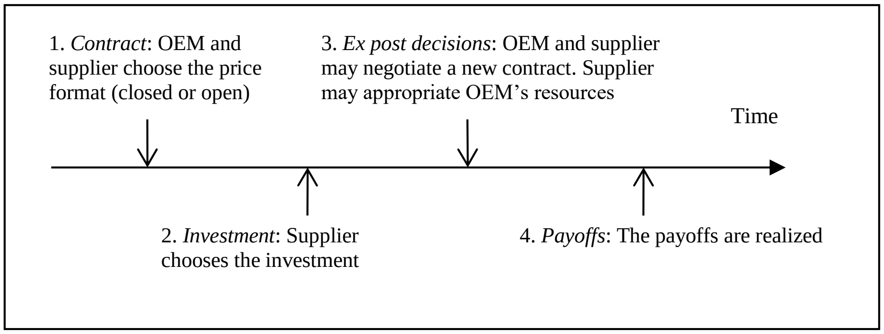

Table 1. Relation of theories on interfirm relationship to our data.

Theory	Main references	Main proposition	Main assumptions	Theoretical predictions and their alignment with our empirical evidence*
Transaction Cost Analysis	Klein et al. (1978); Williamson (1979); Crocker and Reynolds (1993)	Contractual provisions are used to reduce haggling in *ex post* bargaining to enhance parties' *ex ante* dedicated investments	1. Haggling destroys value 2. Writing complete contracts is infeasible 3. Dedicated investments are productive and can be contractible	1. Closed-price contracts are optimal if the benefit of eliminating *ex post* haggling is large (N.A.) 2. Closed-price contracts increase the supplier's dedicated investment in customizing the component (–) 3. Closed-price contracts increase the OEM's value add (–)
Incomplete Contracting Theory	Grossman and Hart (1986); Hart and Moore (1988); Che and Hausch (1999)	Contractual provisions provide incentives for the party whose dedicated investment is more valuable by allocating it a higher share of gains from *ex post* bargaining	1. *Ex post* bargaining does not destroy value 2. Writing complete contracts is infeasible 3. Dedicated investments are productive and non-contractible 4. Closed prices make the OEM residual claimant when the supplier's investment mostly benefits the OEM	When only the supplier invests: 1. Closed-price contracts decrease the supplier's investment (+) 2. Closed-price contracts decrease the OEM's value add (+) 3 Closed-price contracts are associated with low value of OEM resources (–) When both the OEM and the supplier invest: 1. Closed-price contracts decrease supplier's investment (+) 2. Closed-price increases the OEM's value add (−)
Resource-Based View	Wernerfelt (1984); Barney (1986)	Idiosyncratic, immobile resources provide a firm's competitive advantage. Complementary resources brought to collaborations enhance their performance	1. Resources possessed by firms are idiosyncratic 2. Resources are immobile, costly-to-be-imitated, and firm-specific	No specific predictions offered on price formats used in procurement contexts
Integrative Approach on Firm Resources and Governance Choice	Ghosh and John (1999, 2005); Zanarone, Lo, and Madsen (2016)	Contract provisions are used to trade-off efficiency gains created within collaboration and potential harm to pre-existing resources that are external to the collaboration	1. Pre-existing resources are vulnerable to rent seeking and appropriation 2. Dedicated investments simultaneously create values and build up capacity for potential appropriation purposes 3. Direct, explicit safeguards are limited, so indirect incentive mechanisms, such as contracts, are necessary	1. Closed-price contracts are used under high OEM resources (+) 2. Closed-price contracts reduce supplier's dedicated investment (+) 3. Closed-price contracts reduce value add to the OEM's end product (+)

*Note: (+) prediction consistent with our data; (−) prediction inconsistent with our data ; (N.A.) our data not able to test prediction.

Table 2. Measures and descriptive statistics.

Variable	Measure	Mean	S.D.	Min	Max
Supplier's dedicated investment (six items) $\chi^2(9)$ = 20.84; CFI = 0.98; RMSEA = 0.09; reliability = 0.91	1. This supplier has made significant investment in tools and equipment dedicated to the relationship with us. 2. The procedure and routines developed by the supplier for their item(s) are tailored to our particular situation. 3. This supplier has spent significant resources designing the specifications for their item(s) to ensure that it fits well with our production capabilities. 4. We have some usual technological norms and standards which have required extensive adaptation on the part of this supplier. 5. Most of the training that the supplier's people have undertaken related to our requirement for this item(s) cannot be easily adapted for use with another customer. 6. Training personnel has involved a substantial commitment of time and money on the part of the supplier.	3.38	1.05	1	6
Supplier's dedicated investment	Estimate the total dollar value (over all fiscal periods) of this supplier's expenditure for equipment, training, etc., dedicated to facilitating your procurement of the identified item(s). Choose one from: (1) Less than $10,000; (2) $10,000 - $24,999; (3) $25,000 - $99,999; (4) $100,000 - $499,999; (5) $500,000 - $999,999; (6) $1,000,000 - $2,499,999; (7) $2,500,000 or more.	3.44	1.42	1	7
OEM profitability	Relative to what you might have obtained from some other supplier, how profitable is your relationship with this supplier?	5.58	1.25	2	7
End-product enhancement (two items) Reliability = 0.77	1. The image of your end product in your customer's eyes has received a boost due to this relationship. 2. This relationship has helped boost the sales of your end-product. 3. This relationship enables you to differentiate your end-product vis-à-vis your competitors.	3.66	1.42	1	7
Price format (Closed-price contract=1; Open-price contract=0)	How would you describe the pricing arrangement for the item(s) under this contract? Closed-price contract if fixed price or specified prices with verifiable adjustment formulas (e.g., inflation, produce price index, etc.) over the length of the contract. Open-price contract if prices are not specified ahead of shipment or specified prices with negotiated adjustments.	0.82	0.39	0	1
OEM market strength (five items) $\chi^2(5)$ = 7.54; CFI = 0.99; RMSEA = 0.06; reliability = 0.81	1. This end product is very profitable for you. 2. Customers are willing to pay a large premium for your end product. 3. You earn higher margins on your end product than your competition. 4. Customers value your end product more than competing products. 5. You enjoy a number of competitive advantages in your end-product market.	4.42	1.20	1.6	7
Tenure	How long has your business unit had a business relationship with this supplier? (year)	8.17	4.95	1	25
Technological uncertainty (three items) Reliability = 0.81	1. Industry standards for this item's performance specifications are very unpredictable. 2. Industry standards for this item's design specifications are very unpredictable. 3. Technological developments related to this item are very unpredictable.	2.80	1.08	1	6
Interface complexity	Item has a complex interface with other components in the end product.	4.70	1.32	1	7

Component importance	Item is a very important element of the end product.	5.09	1.24	1	7
OEM's relative size	With respect to your last year's sales volume over all products, how large is your firm relative to this supplier?	6.97	14.72	0	100
Number of potential suppliers†	What is the total number of potential suppliers for this item?	33.47	113.16	2	1000
Supplier's irreplaceability	Suppose your firm were to switch suppliers and start purchasing the item(s) from a new supplier. How much time would the switch-over take? (Consider the time required to locate, qualify and train the new source, retrain your employees, make necessary investments, conduct testing, etc.): (1) Less than 1 month; (2) 1 to 3 months; (3) 4 to 6 months; (4) 7 to 9 months; (5) 10 to 12 months; (6) 13 to 24 months; (7) Over 24 months.	3.25	3.21	0.5	18.5
Contract enforceability	The terms of our formal contract can be readily enforced in court, if necessary.	3.83	1.35	1	7
Norm of flexibility (four items) $\chi^2(2) = 2.96$; CFI = 0.99; RMSEA = 0.06; reliability = 0.91	1. Both parties are expected to be flexible in response to requests made by the other. 2. It is expected that parties will make adjustments in the ongoing relationship to cope with changing circumstances. 3. The parties are open to the idea of making changes, even after an agreement is made. 4. Changes in the terms of the contract are not ruled out, if considered necessary.	4.55	0.99	1.5	7
Norm of long-term orientation (four items) $\chi^2(2) = 8.97$; CFI = 0.93; RMSEA = 0.15; reliability = 0.93	1. The parties expect this relationship to last a long time. 2. It is assumed that the renewal of the relationship will generally occur. 3. The parties are expected to make plans not only for the terms of individual purchases, but also for the continuation of the relationship. 4. Parties are expected to focus on long-term goals in this relationship.	4.23	1.43	1	7
Monitoring of supplier (five items) $\chi^2(5) = 4.19$; CFI = 1.00; RMSEA = 0.00; reliability = 0.75	1. Product quality 2. Price competitiveness 3. Item(s) specifications 4. Supplier's manufacturing procedures 5. Supplier's use of quality control procedures	3.91	0.80	1.8	6.6
Control of decision rights (six items) $\chi^2(9) = 26.78$; CFI = 0.89; RMSEA = 0.11; reliability = 0.61	1. Delivery schedule of item(s) 2. Order quantities of item(s) 3. Pricing of item(s) (e.g., price determination, adjustments allowed, etc.) 4. Ongoing design and engineering changes 5. Supplier's production processes and manufacturing technology 6. Supplier's quality control procedures	4.05	0.69	2.3	5.8
OEM's investment (four items) Reliability = 0.89	1. You have made a significant investment in tools and equipment dedicated to the relationship with this supplier. 2. This supplier has some usual technological norms and standards which have required extensive adaptation on your part. 3. Most of the training that the supplier's people have undertaken related to your requirement for this item(s) cannot be easily adapted for use with another customer. 4. Training this supplier's people has involved a substantial commitment of time and money.	3.47	1.18	1	6.5

Number of observations = 161. The anchors for scale points are 1 = "strongly disagree" and 7 = "strongly agree." The table provides an illustrative item for all multi-item scales, except that *Control of decision rights* is rated from "Entirely decided by this supplier" to "Entirely decided by your firm" and *Monitoring of supplier* is rated from "Minimal monitoring of supplier" to "Extensive monitoring of supplier" on a 1 to 7 scale. †We use natural log of this variable in our estimations.

Table 3. Pairwise correlations.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	*Supplier's dedicated investment*	-																		
2	*Amount of supplier's investment*	0.68	-																	
3	*OEM profitability*	0.32	0.33	-																
4	*End-product enhancement*	0.42	0.31	0.22	-															
5	*Price format*	-0.09	0.01	-0.09	-0.33	-														
6	*OEM market strength*	0.27	0.42	0.26	-0.01	0.25	-													
7	*Tenure*	-0.04	0.01	0.13	-0.12	0.09	-0.06	-												
8	*Technological uncertainty*	0.23	0.23	0.20	0.31	-0.18	0.28	-0.30	-											
9	*Interface complexity*	0.16	0.25	0.18	0.06	0.04	0.22	-0.16	0.20	-										
10	*OEM's relative size*	0.22	0.16	0.19	0.05	-0.03	0.26	-0.15	0.07	-0.05	-									
11	*Number of potential suppliers*	-0.31	-0.32	-0.34	-0.38	0.16	-0.24	-0.01	-0.47	-0.28	0.01	-								
12	*Supplier irreplaceability*	0.40	0.38	0.35	0.48	-0.26	0.09	0.01	0.38	0.21	-0.03	-0.37	-							
13	*Component importance*	0.19	0.17	0.21	0.22	-0.08	0.16	-0.03	0.29	0.21	0.03	-0.20	0.35	-						
14	*Norm of flexibility*	0.17	0.02	0.03	0.38	-0.20	-0.29	0.29	-0.03	-0.02	-0.24	-0.07	0.31	0.16	-					
15	*Norm of long-term orientation*	0.13	0.14	0.06	0.16	-0.01	-0.11	0.09	-0.00	0.03	-0.01	-0.01	0.20	0.10	0.37	-				
16	*Monitoring of supplier*	-0.06	-0.02	0.11	0.12	-0.10	0.08	-0.09	-0.02	0.02	0.10	-0.02	0.16	0.21	0.22	0.20	-			
17	*OEM's investment*	0.32	0.13	0.20	0.49	-0.23	-0.15	-0.13	0.16	0.01	-0.00	0.15	0.49	0.12	0.28	0.08	0.08	-		
18	*Control of decision rights*	-0.06	0.00	0.13	0.23	-0.19	0.08	-0.12	0.04	0.06	0.05	-0.12	0.22	0.05	0.25	0.10	0.55	0.31	-	
19	*Contract enforceability*	-0.06	0.03	-0.03	-0.29	0.21	0.14	0.21	-0.10	-0.16	0.01	0.02	-0.13	0.01	-0.14	-0.06	-0.07	-0.26	-0.12	-

Number of observations = 161. Significant at 0.10 when the absolute value of a coefficient of correlation is larger than 0.16.

Table 4. Price format and its effect on supplier's investment.

	Model 1		Model 2	
	(1)	(1')	(2)	(2')
Dependent variables	***Price format*** *Closed-price contract* = 1; *Open-price contract* = 0 (Probit)	***Supplier's dedicated investment*** (Ordered probit)	***Price format***: *Closed-price contract* = 1; *Open-price contract* = 0 (Probit)	***Amount of supplier's dedicated investment*** (Ordered probit)
Main Variables				
Price format		-1.39***		-1.72***
		(0.07)		(0.05)
		H₁(–)		**H₁(–)**
OEM product strength	0.48***	0.47***	0.53***	0.59***
	(0.14)	(0.03)	(0.13)	(0.02)
	H₃(+)		**H₃(+)**	
Other Variables				
Tenure	0.01	-0.01**	0.01	-0.01
	(0.03)	(0.01)	(0.03)	(0.00)
Technological uncertainty	-0.34**	-0.25***	-0.31*	-0.11***
	(0.15)	(0.03)	(0.16)	(0.02)
Interface complexity	0.11	0.10***	0.11	0.10***
	(0.11)	(0.02)	(0.12)	(0.01)
OEM's relative size	-0.01	0.01***	-0.01	0.00**
	(0.01)	(0.00)	(0.01)	(0.00)
Log (*No. of potential suppliers*)	0.11	-0.21***	0.13	-0.18***
	(0.14)	(0.02)	(0.14)	(0.02)
Supplier irreplaceability	-0.28*	0.02	-0.19	0.12***
	(0.16)	(0.03)	(0.16)	(0.03)
Component importance	-0.02	0.04	-0.09	-0.03
	(0.12)	(0.03)	(0.12)	(0.01)
Norm of flexibility	-0.26	0.23***	-0.15	0.28***
	(0.19)	(0.06)	(0.19)	(0.02)
Norm of long-term orientation	0.13	0.10***	0.13	0.12***
	(0.11)	(0.02)	(0.11)	(0.01)
Monitoring of supplier	-0.17	-0.14***	-0.04	-0.14***
	(0.22)	(0.03)	(0.22)	(0.03)
OEM's investment	-0.06	0.26***	-0.08	-0.02
	(0.14)	(0.03)	(0.14)	(0.02)
Control of decision rights	-0.24	-0.72***	-0.31	-0.39***
	(0.27)	(0.04)	(0.27)	(0.03)
Contract enforceability	0.17*		0.17ǂ	
	(0.10)		(0.11)	
SIC35	-0.13	-0.15***	0.01	-0.06
	(0.34)	(0.05)	(0.33)	(0.04)
SIC36	0.08	0.15***	0.18	0.53***
	(0.33)	(0.05)	(0.33)	(0.04)
Constant	1.75		0.80	
	(1.54)		(1.55)	
ρ	0.705*** (0.001)		0.706*** (0.001)	
Test for endogeneity of *Contract form* (H_0: ρ=0): χ^2 statistic	36.72***		45.46***	
Wald χ^2 statistic	2135.23***		4315.80***	
McFadden's pseudo R^2	0.32		0.29	

N=161. Columns 1 and 1' represent one set of regressions jointly estimated by FIML. Similarly for Columns 2 and 2'. Robust standard errors in parentheses. Two-tail test: *** significant at 0.01; ** significant at 0.05; * significant at 0.10. One-tail test: ǂ significant at 0.10. For brevity, results of threshold cuts are omitted. **H(–)** denotes negative coefficient predicted, and **H(+)** denotes positive coefficient predicted. **H_1**: A closed-price contract induces the supplier to undertake a lower level of investment than it would under an open-price contract. **H_3**: A closed-price contract, but not an open-price contract, is used when the value of M's pre-existing resources is sufficiently high.

Table 5. Price format and its effect on value-add to OEM's end product.

	Model 1		Model 2	
	(1)	(1')	(2)	(2')
Dependent variables	***Price format*** *Closed-price contract* = 1; *Open-price contract* = 0 (Probit)	***OEM end-product profitability*** (Ordered probit)	***Price format***: *Closed-price contract* = 1; *Open-price contract* = 0 (Probit)	***OEM end-product enhancement*** (Ordered probit)
Main Variables				
Price format		-1.41***		-1.47***
		(0.07)		(0.47)
		H_2(–)		**H_2(–)**
OEM product strength	0.65***	0.34***	0.57***	0.23***
	(0.14)	(0.03)	(0.16)	(0.10)
	H_3(+)		**H_3(+)**	
Other Variables				
Tenure	-0.00	0.06***	0.01	-0.04***
	(0.03)	(0.01)	(0.04)	(0.00)
Technological uncertainty	-0.56***	-0.34***	-0.37**	-0.09***
	(0.16)	(0.03)	(0.18)	(0.02)
Interface complexity	0.10	0.14***	0.16	-0.05***
	(0.11)	(0.02)	(0.13)	(0.01)
OEM's relative size	-0.01	0.02***	-0.02*	0.00**
	(0.01)	(0.00)	(0.01)	(0.00)
Log(*No. of potential suppliers*)	0.15	-0.20***	0.19	-0.25***
	(0.15)	(0.02)	(0.16)	(0.01)
Supplier irreplaceability	-0.20	0.22***	-0.21	-0.00
	(0.16)	(0.04)	(0.19)	(0.01)
Component importance	0.08	0.19***	-0.03	0.06***
	(0.12)	(0.02)	(0.13)	(0.01)
Norm of flexibility	-0.33	-0.23***	-0.27	0.34***
	(0.21)	(0.03)	(0.22)	(0.03)
Norm of long-term orientation	0.18	0.08***	0.10	0.02
	(0.11)	(0.02)	(0.12)	(0.01)
Monitoring of supplier	-0.13	0.03	-0.13	0.09***
	(0.24)	(0.04)	(0.27)	(0.02)
OEM's investment	0.11	0.24***	0.08	0.33***
	(0.14)	(0.03)	(0.16)	(0.02)
Control of decision rights	-0.13	-0.14***	-0.21	-0.19***
	(0.28)	(0.05)	(0.30)	(0.03)
Contract enforceability	0.26**		0.23**	
	(0.12)		(0.12)	
SIC35	0.15	-0.20***	0.12	0.13***
	(0.32)	(0.07)	(0.37)	(0.04)
SIC36	0.17	-0.09	0.25	0.29***
	(0.33)	(0.06)	(0.37)	(0.04)
Constant	-0.50		0.06	
	(1.76)		(1.79)	
ρ	0.703*** (0.00)		0.706** (0.000)	
Test for endogeneity of *Contract form* (H_0: ρ=0): χ^2 statistic	36.96***		29.18***	
Wald χ^2 statistic	1451.92***		4663.01***	
McFadden's pseudo R^2	0.28		0.29	

N=161. Columns 1 and 1' represent one set of regressions jointly estimated by FIML. Similarly for Columns 2 and 2'. Robust standard errors in parentheses. Two-tail test: *** significant at 0.01; ** significant at 0.05; * significant at 0.10. One-tail test: ǂ significant at 0.10. For brevity, results of threshold cuts are omitted. **H(–)** denotes negative coefficient predicted, and **H(+)** denotes positive coefficient predicted. **H_2**: M's value add from incorporating S's component into the end product is larger under an open-price contract than that under a closed-price contract. **H_3**: A closed-price contract, but not an open-price contract, is used when the value of M's pre-existing resources is sufficiently high.