Governing Investment in Inter-Firm Collaborations: the Role of Contracts

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Dedicated investments are a key driver of value creation in interfirm collaborative relationships. At the same time, dedicated investments are potentially vulnerable to holdup, and might also be used opportunistically, to appropriate a partner's pre-existing resources. Two prominent theoretical frameworks – transaction cost economics and formal incomplete contracting theory – have investigated how contracts and governance mechanisms can be used to elicit optimal levels of dedicated investment in the face of these hazards. Yet, the relative empirical relevance of these frameworks has been rarely assessed. Our paper makes important progress on this agenda, both theoretically and empirically. Theoretically, we develop a model of the relationship between an OEM and a supplier that nests the TCE and ICT approaches, and shows that they lead to fundamentally different predictions on how different contractual price formats affect the supplier's dedicated investment. Empirically, we test our framework on a dataset of component procurement contracts and find that consistent with a "resource protection" version of the ICT model, and in contrast with the TCE model, OEMs use fixed, or "closed" price formats in their contracts with suppliers when their pre-existing resources are more valuable, despite the fact that closed price formats reduce both the supplier's dedicated investment *and* its value-add to the OEM's end product. This evidence suggests that parties, cognizant of the "dark side" of entering inter-firm collaborations, strategically balance the conflicting goals of safeguarding pre-existing resources and creating value.

Keywords: Contract, Price Format, Governance, Firm Resources and Capabilities, Transaction Cost Economics, Resource-Based View, Specific Investments

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

INTRODUCTION

Value creation in collaborative interfirm relationships, such as supply chains and distribution networks, requires dedicated investments in physical assets, technology, and knowledge acquisition (e.g., Parkhe 1993; Dyer 1996; Kang Mahoney, and Tan 2009; Nan 2013). At the same time, these dedicated investments are a frequent source of contention between the collaborating firms. On the one hand, they create dependency and thus are vulnerable to the classic holdup problem (e.g., Klein, Crawford, and Alchian 1978; Williamson 1979). On the other hand, dedicated investments may provide one party in the relationship with access to its partner's pre-existing resources such as brand and customer equity, thereby enabling their opportunitistic appropriation (e.g., Hamel et al. 1989; Barney 1991; Arrunada and Vazquez 2006; Alcacer and Oxley 2014). An important research question in strategic management is then how to design far-sighted contractual mechanisms to elicit desired dedicated investments in the face of these potential market frictions (e.g., Mahoney and Qian 2013).

Contracts are often used to govern collaborative interfirm relationships (Weber, Mayer, and Wu 2009; Oh, Martynov, and Poppo 2014). Contractual terms specifying how the price is determined (hereafter, "price formats") are a crucial aspect of these contracts as they potentially affect the incentives of participants to undertake dedicated investment (e.g., Zenger 2016). Two prominent theoretical frameworks – Transaction Cost Economics, or TCE (e.g., Klein, Crawford, and Alchian 1978; Williamson 1979, 1983) and formal Incomplete Contracting Theory, or ICT (e.g., Hart and Moore 1988; Che and Hausch 1999) – have been developed to explain how contracts, and particularly price formats – govern dedicated investments in interfirm relationships. However, while the TCE approach has been empirically examined by some important studies (reviewed below), the ICT approach, and its predictive power relative to TCE, remains untested.

There are three possible reasons for this gap. First, the factthat both TCE and ICT emphasize incomplete contracting, investment, and holdup has prevented much of the literature from appreciating the two theories' fundamentally different premises and predictions regarding contract design.[1] Second, while formal ICT models explicitly compare the levels of dedicated investment under different contractual forms, the more informal theoretical statements of TCE rarely do so, thus making a direct comparative assessment of the two theories challenging. Third, TCE is a relatively uniform theory; however, the predictions of ICT models on how contracts affect dedicated investments are sensitive to hard-to-observe features of collaborative relationships, most notably whether dedicated investments primarily benefit the party undertaking them or the counterpart (Che and Hausch 1999), and whether they have harmful effects in addition to productive ones (Zanarone, Lo, and, Madsen 2016).

The contribution of our paper is to develop and implement a comparative test of the ICT approach to interfirm governance that allows to clearly distinguish it from the TCE approach. We focus on the contractual relationship between an original equipment manufacturer (OEM) and a supplier who invests into producing a dedicated component for the OEM (e.g., Dyer 1996; Bensaou and Anderson 1999; Kang, Mahoney, and Tan 2009; Lo, Frias, and Ghosh 2012). OEM-supplier contracts typically use two alternative price formats: "closed price", which specifies the price before the supplier invests (ex ante), and "open price", which allows for the price to be negotiated after the investment is sunk (ex post). We develop a unified analytical framework that nests the TCE and ICT approaches to study how these alternative price formats affect dedicated investments and value creation in the OEM-supplier relationship. The model shows that TCE and ICT generate competing

[1] Whinston (2003) makes a similar point about the TCE and ICT explanations for vertical integration.

hypotheses, which we empirically test using a proprietary sample of procurement contracts for engineered components in the U.S.

In our TCE model, which formalizes and adapts Williamson's standard framework (e.g., Williamson 1979, 1983), the supplier makes a *contractible* dedicated investment, such as machinery and know-how that is specific to the buyer. Once the investment is sunk, the supplier is locked into a bilateral monopoly relationship with the OEM. This may lead the two parties to engage in wasteful "haggling" if the component's price is open to ex post negotiation. While the supplier's investment is contractible, haggling costs reduce its expected value to the OEM and therefore the price the OEM is willing to pay for it. As a result, high enough haggling costs prevent the OEM and the supplier from contracting the efficient level of dedicated investment. By fixing the price before the investment is sunk, a closed-price contract commits the OEM and the supplier not to haggle, thereby restoring their incentives to contract for the efficient investment level.[2]

We compare the TCE model described above with two versions of the ICT model that naturally fit our context of OEM procurement contracts. In both versions, as standard in ICT but in contrast to TCE, the supplier's dedicated investment is *noncontractible*, for instance, because it involves the acquisition of human capital, know-how, or customized production capability (e.g., Kang, Mahoney, and Tan 2009; Lo, Frias, and Ghosh 2012; Eapen and Krishnan 2019). Moreover, while ex post bargaining may occur in the absence of a closed price, ICT assumes that it does not generate "haggling costs". Thus, price formats affect the supplier's dedicated investment not because they remove wasteful haggling, as in TCE, but rather because they determine how the value created by such investment is divided between the OEM and the supplier. Specifically, while an

[2] Papers in the TCE tradition often consider reduced flexibility and adaptability to unforeseen contingencies as a potential downside of closed price formats (e.g., Crocker and Reynolds 1993; Bajari and Tadelis 2001; Kalnins and Mayer 2004). We deliberately abstract from the effect of price formats on adaptation in our models; instead, we focus on their effect on dedicated investment and value creation.

open price format allows the supplier to capture part of the investment's value via ex post bargaining, and therefore gives it some incentive to invest, a closed-price format removes the supplier's incentive to invest altogether as it makes the OEM sole residual claimant of the investment's value created in the relationship. The fact that a closed price on our two ICT models *reduces* rather than increasing the supplier's dedicated investment and the component's value completely distinguishes the TCE and ICT approaches.

Despite their similarities, our two analytical ICT models differ in the nature of the supplier's investment. In the first ICT model, adapted from Che and Hausch (1999), the investment only has the productive effect of increasing the component's value to the OEM (e.g., Dyer 1996; Shervani, Frazier, and Challagalla 2007; Nan 2013). We refer to this approach as "classic" ICT. In contrast, in the second model, adapted from Zanarone, Lo, and Madsen (2016), the supplier's investment may also be used to gain competitive advantage at the expense of the OEM (Barney 1991; Hamel, Doz, and Prahalad 1989). This can occur, for instance, if the supplier uses its acquired capabilities to compete with the OEM, thereby appropriating its pre-existing resources such as brand and customer equity (Arruñada and Vázquez 2006; Alcacer and Oxley 2014). We refer to this second approach as the "resource protection perspective" or RPP, because it integrates the classic ICT framework with the Resource Based View's emphasis on firm resouces and capabilities (e.g., Wernerfelt 1984; Peteraf 1993) that may subject to appropriation (Hamel, Doz, and Prahalad 1989). While delivering similar predictions on the effect of price formats on dedicated investment and value, classic ICT and RPP generate sharply different predictions on the price-format choice. In particular, while the OEM in classic ICT will *never* choose a closed-price contract that reduces the component's value, RPP predicts that the OEM *will* do so if its appropriable pre-existing resources are valuable enough.

Our empirical analysis examines these competing hypotheses of TCE, classic ICT, and RPP using proprietary survey data on 155 procurement contracts for engineered components between

OEMs and suppliers in the U.S. We treat supplier's dedicated investment and value creation for the OEM as the collaboration's outcomes to be explained (e.g., Madhok and Tallman 1998; Bensaou and Anderson 1999; Nickerson, Hamilton, and Wada 2001; Kang, Mahoney, and Tan 2009), and use two-step endogenous switching regressions (Maddala 1983; Wooldridge 2010) to account for these endogenous choices between closed and open price formats. We find that (i) a closed-price format ise more likely to be used when the OEM's pre-existing resources – measured by brand and customer equity – haveare high value, (ii) the supplier's dedicated investment is lower under the closed-price than under the open-price contract, and (iii) the value created by the supplier for its OEM through dedicated investment is also lower under the closed-price than that under open-price contract. All of these results are inconsistent with the TCE model. Results (ii) and (iii) are consistent with the classic ICT model, while result (i) is only consistent with the RPP model. Our results are robust after we control for other well-known governance mechanisms such as monitoring, mutual hostages, and relational norms.

Altogether, our empirical analysis suggests that TCE, with its focus on contractible investment and haggling costs, misses important channels through which price formats shape dedicated investment in buyer-supplier relationships. By emphasizing the negative effect of closed prices on noncontractible investment, ICT has greater explanatory power in our empirical setting. However, the evidence also suggests that a classic ICT approach, in which dedicated investments are purely productive, may be insufficient to explain the use of closed-price contracts in contexts – such as OEM-supplier contracts – in which firms bring appropriable pre-existing resources to their collaborative relationships. Our results suggest that the integrative RPP approach, which emphasizes both value creation as the "bright side" and potential resource appropriation as the "dark side" of dedicated investments, importantly complements classic ICT in those contexts. To put it differently, more than simply safeguarding and thus incentivizing supplier investments (as in

TCE and classic ICT), price formats – or in general, govenance forms – can be also used to safeguard the OEM *against* such investments.

LITERATURE REVIEW

Our paper relates to a vast literature in strategy and industrial organization that examines the governance role of formal contracts in interfirm collaborations. This literature has been reviewed, among others, by Shelanski and Klein (1995), Lafontaine and Slade (2013), Carter and Hodgson (2006), Macher and Richman (2008), Weber et al. (2009), and Oh et al. (2014). Our study offers several novel contributions, which we discuss in detail below.

First, our paper provides the first comparative test of the TCE and ICT theories of contracts as a means to govern dedicated investments. Our key contribution here is methodological: by nesting TCE and ICT into an analytical model in which both contractual price formats and dedicated investments as endogenously determined, we make it possible to compare and test their predictions on how closed vs. open price formats affect the equilibrium investment levels. In contrast to our approach, the standard TCE framework treats dedicated investments as exogenous and argues that they generate "haggling costs," and that these cost can be limited by fixing the price for an extended time period (e.g., Williamson 1975, 1979; Masten 1988). This argument leads to the frequently tested prediction that closed price formats are more likely to be chosen the more specific are the parties' investments (Joskow 1987) and the lower the need is to adapt contract terms to the environment (e.g., Crocker and Masten 1988; Crocker and Renolds 1993; Corts and Singh 2004; Kalnins and Mayer 2004). As such, the TCE framework as stated usually does not allow for a test of how price formats affect dedicated investments, and hence for a comparison with the formal ICT approach in which these investments are endogenously determined. Our model and empirical analysis show that (at least in our context of OEM-supplier relationships) running a fair "horserace" between TCE and ICT is important because the two theories' predictions on how price formats affect dedicated investment are sharply different.

Second, by distinguishing between predictions of the classic ICT model in which dedicated investment is purely productive, and those of the RPP model in which investment may enable appropriation of pre-exiting resources, our paper provides the first empirical evidence that closed-price formats may optimally disincentivize dedicated investments. Earlier research has recognized that firms possessing pre-existing endowments and resources are likely to seek governance structures to mitigate appropriation hazards (e.g., Ghosh and John 1999). More recently, Zanerone et al. (2016) have introduced the idea that dedicated investments can facilitate resource appropriation and that optimal governance induces investment levels that balance the conflicting goals of value creation and resource protection. Altogether, this theoretical perspective complements the Resource-Based View, or RBV, which emphasizes how firms exploit their heterogeneous, immobile resources to achieve competitive advantage (e.g., Wernefelt 1984; Barney 1986; Grant 1996) but is silent about how governance prpotects these resources. While RPP is theoretically appealing, there is still limited empirical evidence on it. In OEM-supplier relations, Ghosh and John (2005) find a positive correlation between the completeness of OEM-supplier contracts and the OEM's dedicated investments. However, they do not consider how pre-existing resources would influence contracts and, in turn, investments. Closer to our work, Lo et al. (2012) investigate the impact of an OEM's pre-existing resources on contract choice, but do not look at the link between contract form on the one hand, and dedicated investments and value creation on the other.

Lastly, studies such as Bensaou and Anderson (1999) and Kang et al. (2009), which do not strictly fall into TCE or ICT, have empirically looked at the determinants of dedicated investments by treating them as dependent variables also in OEM-supplier contexts (e.g., manufacturering in automobiles and electronics). However, they ignore the role of contracts, pre-existing resources, or value creation in their analysis.

MODELS AND HYPOTHESES

In this section, we develop a simple formal model of the contractual relationship between an OEM and a component supplier. In the model the two parties agree on a price format (closed versus open), after which supplier subsequently makes a dedicated investment that creates value for the OEM. We begin by describing the model's general features, then we analyze its predictions on the choice of price formats and investment levels under the alternative contracting assumptions of TCE, classic ICT, and RPP.

Model setup

Consider an OEM (M) and a supplier (S), both risk-neutral. Prior to entering a contractual relationship with S, M possesses pre-existing resources of value $\omega \in \mathbb{R}^{+}$, such as customer brand equity and reputation, and product-design architecture. M seeks to procure a component from a supplier (S) that is to be integrated into M's end-product which will be sold downstream to M's customers. S can make investments to customize the component to the OEM's end-product and hence adds value to the OEM'S product.

Consistent with industry practice, we organize the timeline of this collaboration as follows (see Figure 1). At stage 1, M and S contractually agree on the price format for the component being procured. They either specify the final price p upfront (i.e., choose a closed-price format) or agree to negotiate it *ex post* (i.e., choose an open-price format). In line with the Coase theorem, we assume M and S choose the price format that maximizes the net joint surplus.

At stage 2, S chooses its level of investment ($a \in \mathbb{R}^{+}$) in customizing the component to M's product design, technological, and customer needs. S's investment cost, for simplicity, equals the investment level, a. Consistent with both TCE and ICT, we assume S's investment generates a value add, $q(a)$, for M, which is increasing in the investment level ($q_a > 0$) and concave ($q_{aa} < 0$). Consistent with RPP, we assume the investment also potentially enables S to appropriate M's resources (Zanarone, Lo, and Madsen 2016).[3] To capture this idea analytically, we assume a share $\beta(a) \in [0,1]$ of the value ω of the OEM's resources is captured by, and fully transferred to, S.

At stage 3, if they have chosen the open-price format, M and S bargain over the price p. S then delivers the component to M at the agreed upon price. Consistent with the TCE literature, we allow for potential bargaining or "haggling" costs to be incurred at this stage. For instance, the parties may waste time and resources to improve their negotiating position (Masten 1988). Also, S may "retaliate" against M – for instance, by delivering the component late – if dissatisfied with the negotiated price (Hart and Moore 2008). We model haggling costs in a simple, reduced form fashion by assuming that if M and S negotiate the price at stage 3 (that is, if they have chosen an open-price format) they incur a fixed cost k. Similar results would obtain if we modeled wasteful haggling as a reduction in the component's value-add. Without loss of generality, we assume haggling costs are equally split between M and S.

Finally, at stage 4, M and S obtain their payoffs as a result of the chosen price format, S's investment, and haggling. M's payoff includes the added value from the customization due to S's investment, but also the potential loss it suffers if S appropriates some of its pre-existing resources.[4]

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[3] We assume for simplicity that any loss of value to the 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. Our qualitative results are more general and would hold *a fortiori* if the OEM'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.

[4] 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. Zanarone et al. 2016 work out such an extension to repeated interactions detailed in pp. 2115 - 2117.

< INSERT FIGURE 1 ABOUT HERE >

A few features of our model deserve further discussion. First, while environmental uncertainty generally affects inter-firm governance and performance, we abstract from it here in order to focus 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 uncertainty in our empirical exercise. Second, in order to keep the analysis simple by focusing on price formats, our model abstracts from other governance and safeguard mechanisms, such as relational norms (e.g., Macneil 1980; Heide and John 1990; Poppo and Zhou 2014), monitoring, control rights, hostages (e.g., Williamson 1983; Anderson and Weitz 1992), and in the case of resource appropriation, non-compete covenants and trade secret provisions (e.g., Liebeskind 1996, 1997; Pooley, 1997; Arora and Merges 2004; Garmaise 2009). We control for the use of complementary governance tools in our empirical analysis. Finally, we focus on a model in which only the supplier mkes a dedicated investment. While this is a natural representation of OEM-supplier relationships, in principle the OEM may also make dedicated investments – say, in training the supplier – and these investments may both create value (e.g., Kang et al. 2009) and lead to the appropriation of the supplier's pre-exting resources. It is easy to show that our predictions on how price formats affect investment in the TCE, ICT and RPP approaches are robust to the inclusion of OEM dedicated investments.[5]

Given the general setup described above, we now analyze three versions of the model that reflect the TCE, classic ICT, and RPP approaches to price formats. Each of these three elemental models requires different informational assumptions and restrictions on key parameters.

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[5] The model with two-sided investments is available from the authors upon request.

An elemental TCE model

The key friction in TCE, which creates a tradeoff between closed- and open-price formats, is given by the parties' inability to commit against wasteful haggling activities once they are locked into a bilateral monopoly rerlationship. In the words of one of the pioneers of this literature: "The role of contracts is to prevent such activities from dissipating too large a portion of the gains from trade by stipulating acceptable behavior at the outset of a transaction-specific relationship. But contracts incur expenses in both specification and enforcement that limit their usefulness" (Masten 1984, p.405).

We capture this feature in our elemental TCE model by assuming that the haggling cost parameter is positive, $k > 0$, and non-contractible. All other variables in the model – particularly, whether or not M and S trade the component, the price p at which trade occurs, and S's dedicated investment – are assumed to be contractible. This second assumpton is consistent with the fact that classic TCE studies focus on contractible dedicated investments such as plant co-location (Klein, Crawford. and Alchian 1978; Masten 1984; Joskow 1986) or client-specific equipment design (e.g., Nickerson and Silverman, 2003).

Additionally, since the appropriation of pre-existing resources is not discussed in the TCE literature, we mute it in this section by assuming that $\beta(a) = 0$ for all a. It should become clear in a moment that because S's investment is contractible, our results on the relationship between price formats and dedicated investment in an elemental TCE model would continue to hold if we allowed appropriation by the supplier.

As a result of our assumptions, in the TCE model the contract that M and S sign at stage 1 includes a price format (closed versus open), an actual price level p if the close format is chosen, a level of dedicated investment a, and a transfer $t \in \mathbb{R}^+$ to be paid by M to S to cover the contracted investment's cost. Examples of this transfer could be the OEM giving the supplier a deposit or an advance partial payment upon siging the procurement contract. The analysis is fairly simple. Under a closed pice format, the price is fixed at the outset so there is no bargaining at stage 3 of the model, and therefore there are no haggling costs. Moreover, since the investment is contractible, at stage 2 S will implement the investment level contracted with M at stage 1. Anticipating that, at stage 1 M and S choose the price p, the investment level a and the transfer t, to maximize their joint surplus:

$$JS(a) \equiv \omega + q(a) - a,$$

subject to the contract being profitable for both M and S (participation constraints):

$\omega + q(a) - p - t \geq 0$ for M,

$p + t - a \geq 0$ for S.

Any price and upfront transfer that cover S's investment cost without exceeding M's gains from the relationship, $p + t \in [a, \omega + q(a)]$, satisfy both parties' participation constraints. Clearly, for any investment level a there are prices and upfront transfers in this range so long as the investment generates positive surplus, that is, if $JS(a) \geq 0$. Therefore, under a closed price format M and S will agree on the "first best" investment level that maximizes the joint surplus:

$$a^C \equiv a^{FB} \equiv argmax_a\{s(a)\} > 0.$$

Under an open pice format, M and S negotiate the price at stage 3, and therefore they incur the haggling cost k. To facilitate comparison with ICT in the next sections, and without loss of generality, we assume that following the stage-3 negotation, the gains from trade, given by $q(a)$, are split between M and S according to the Nash Bargaining Solution – that is, each party gets its outside option (which is ω for M and zero for S) plus half of the total net gains from trade, that is, the sum of the payoffs obtained by the parties if S sells the component to S minus the sum of their outside options.[6] This is given by $q(a) - k$. As a result, the payoffs received by M and S at stage 4 (gross of stage-2 investment costs) are:

$\pi_M^{TCE} \equiv \omega + \frac{1}{2}q(a) - \frac{k}{2}$ for M, and

$\pi_S^{TCE} = \frac{1}{2}q(a) - \frac{k}{2}$ for S.

As before, S implements at stge 2 the investment level contracted with M at stage 1. Finally, anticipating the outcome of ex post bargaining, at stage 1 M and S choose the investment level a and the upfront transfer t, to maximize the joint surplus

$JS(a) - k \equiv q(a) - a - k,$

subject to the participation constraints:

$\pi_M^{TCE} - t \geq 0$ for M,

$\pi_S^{TCE} + t - a \geq 0$ for S.

Any upfront transfer that covers S's investment cost (net of the gains from bargaining) without exceeding M's own gains, $t \in [a - \pi_S^{TCE}, \pi_M^{TCE}]$, satisfies both parties' participation constraints. Clearly, for any investment level a there are prices and upfront transfers in this range so long as the investment generates surplus in excess of haggling costs: $JS(a) \geq k$. This joint participation constraint is tighter than under a closed price format. If the haggling cost is small enough, such that $JS(a^{FB}) \geq k$, M and S will agree on the first best investment level as under the closed price format. However, if the haggling cost is large, $k > JS(a^{FB})$, there is no positive investment level on which M and S will agree (because any investment below a would generate even smaller surplus than $s(a^{FB})$). Thus, S's investment under an open price contract is:

[6] Asymmetric bargaining power and hence unequal sharing parameters will generate identical qualitative results in comparative statics in terms of the effect of pre-existing resources on price formats, and the effect of price formats on investments and outcomes. Technical proof is available upon request. In our empirical analysis, we do control for bargaining power by using measures of relative relative OEM-supplier size, importance of component to end product, number of potential suppliers for the component, and supplier irreplaceability.

$$a^{O} \equiv \begin{cases} a^{FB} \; if \; JS(a^{FB}) \geq k, \\ 0 \; if \; JS(a^{FB}) < k. \end{cases}$$

Consistent with the standard TCE argument, our analysis above shows that by preventing M and S from engaging in wasteful ex post haggling, a closed price format (weakly) increases S's ex ante dedicated investment a, and the investment's value $q(a)$, relative to the open price format. Since the investment level under an open price format is (wealy) below the first best level achieved under a closed price format, this analysis also implies that in our elemental TCE model, a closed price format is (weakly) optimal.[7]

H1: *In the TCE model, (a) the supplier's dedicated investment under a closed-price format is at least as large as under an open-price format ($a^C \geq a^O$); (b) the OEM's value add from incorporating the supplier's component into its end product under a closed-price format is at least as large as under an open-price format ($q(a^C) \geq q(a^O)$); and (c) the OEM and the supplier will always choose the closed price format over the open price one.*

An elemental classic ICT model

Like TCE, classic ICT does not consider resource appropriation. Consistent with that, we continue to assume in this section that $\beta(a) = 0$ for all a. At the same time, ICT differs from TCE in two fundamental respects. First, haggling costs do not play a role in it. Second, ICT focuses on *non-contractible* dedicated investments and on how governance forms, including price formats, shape the parties' incentives to undertake them (e.g., Grossman and Hart 1986: Hart and Moore 1988). To capture these two essential features of ICT in our elemental model, we assume that there are no haggling costs, $k = 0$, and that S's investment a, and its value to M, $q(a)$, are *observable* to M and S, but *non-verifiable*. Therefore, M and S neither contract for an investment nor an upfront

[7] The TCE literature has highlighted reasons why an open price contract may be optimal even if it reduces dedicated investment, most notably the fact that the open format may facilitate ex post renegotiation of the good's desired features in an uncertain environment (e.g, Crocker and Reynolds 1993; Bajari and Tadelis 2001).

transfer at stage 1, and S chooses the investment non-cooperatively at sage 2. In contrast, whether or not M and S trade the component and the price p at which trade occurs continue to be contractible.

Under a closed-price format, the price is specified ex ante, at stage 1. Therefore, when choosing its investment level at stage 2, S simply maximizes the gains from selling the component to M at the pre-specified price minus the investment's cost:

$$a^C \equiv argmax_a\{p - a\} = 0.$$

In words, since a closed price format makes M full residual claimant of the investment's value, S has no incentive to invest.

As in the TCE model, under an open price contract M and S bargain over the price at stage 3 and their payoffs are determined by the Nash Bargaining Solution. Unlike in the TCE model, however, M and S do not incur haggling cost at stage 3. Therefore, the gross payoffs M and S receive at stage 4 after bargaining are given by:

$\pi_M^{IC} \equiv \omega + \frac{1}{2}q(a)$ for M, and

$\pi_S^{IC} = \frac{1}{2}q(a)$ for S.

Anticipating this outcome, S chooses the investment level at stage 2 to maximize the difference between its post-bargaining payoff and the investment cost:

$$a^O \equiv argmax_a\{\pi_S^{IC} - a\}.$$

The first-order condition for the investment to maximize S's net payoff is that the investment's marginal benefit be equal to its marginal cost, that is:

$$\frac{1}{2}q'(a^O) = 1.$$

Given our assumption that $q(a)$ is a concave function — that is, $q''(a) < 0$ — this first order condition fully characterizes S's investment level under an open-price contract, and guarantees that S will choose a positive investment level: $a^O > 0$. At the same time, S's investment under an open price format will be below the first best level because S only appropriates (through bargaining) half of the investment's value.

Our analysis of the ICT model generates results that are opposite to those of the TCE model. In the ICT model the key contractual friction is not haggling costs but rather the need to incentivize S to undertake the desired investment level. By making M full residual claimant of the investment's value, a closed price format mutes S's incentive to invest. In contrast, an open price format gives S some incentive to invest becase it allows S to appropriate a share of the investment's value while bargaining with M, ex post, over the price. Thus, the ICT model implies that S's dedicated investment a, and consequently the investment's value add $q(a)$, is higher under an open price format than under a closed price one. Since the open-price investment is below the first best level but higher than the closed-price level, our analysis also implies that in the elemental ICT model, an open price format is optimal.[8]

H2: *In the ICT model, (a) the supplier's dedicated investment under a closed-price format is smaller than under an open-price format ($a^C < a^O$); (b) the OEM's value add from incorporating the supplier's component into its end product under a closed-price format is also smaller than under an open-price format ($q(a^C) < q(a^O)$); and (c) the OEM and the supplier will always choose the open price format over the closed price one.*

An elemental RPP model

RPP is an incomplete contracting model in which S's investment may lead to both value creation (as in classic ICT and TCE) and appropriation of M's pre-existing resources. Accordingly, in this section we maintain the same set of assumptions as in the classic ICT model, except that we

[8] In a model with two-sided investments an open price format that reduces S's investment may be optimal. However, that will only occur if the open price format simultaneously increases M's investment, such that its net effect on the component's value is positive. Thus, our hypothersis 3 below, on the comparative predictions of classic ICT and RPP, is still valid under this richer version of the classic ICT model.

now assume that the appropriation share $\beta(a)$ is an increasing ($\beta_a > 0$) and concave ($\beta_{aa} < 0$) function of S's investment and concave. Consistent with the incomplete contracting logic, we also assume that how much of M's resources S appropriates, $\beta(a)\omega$, is *observable* to M and S but *non-verifiable*. Therefore, no contracts contingent on $\beta(a)\omega$ can be enforced in court.

Under a closed-price format the price is specified ex ante, at stage 1. Therefore, when choosing its investment level at stage 2, S maximizes the pre-specified price, plus the value of M's resources that S expectes to appropriate as a reslt of its dedicated investment, minus the investment's cost:

$$a^C \equiv argmax_a\{p + \beta(a)\omega - a\}.$$

The first-order condition for S's problem is that the investment's marginal benefit, which is now given by the increase in S's share of M's resources, be equal to its marginal cost, that is:

$$\beta'(a^C)\omega = 1.$$

Given our assumption that $\beta(a)$ is a concave function this first order condition fully characterizes S's investment level under a closed-price fomat, and guarantees that S will choose a positive investment level: $a^C > 0$. Notice that since S's appropriation of M's resources does not increase the joint surplus, S's investment level under a closed price format may be below or above the first best level. In particular, S will overinvest (underinvest) relative to the first best if M's appropriable resources have a sufficiently high (low) value ω.

As in the classic ICT model, under an open price contract M and S bargain over the price at stage 3 and their payoffs are determined by the Nash Bargaining Solution. However, while M's an S's joint gains from exchanging the component are the same as in the classic ICT model, the possibility of resource appropriation reduces M's outside option and increases S's one. As a result, M receivs a lower gross payoff at stage 4, and S receives a higher gross payoff, than in the ICT model:

$\pi_M^{RPP} \equiv [1-\beta(a)]\omega + \frac{1}{2}q(a)$ for M, and

$\pi_S^{RPP} = \beta(a)\omega + \frac{1}{2}q(a)$ for S.

Anticipating this outcome, S chooses the investment level at stage 2 to maximize the difference between its post-bargaining payoff and the investment cost:

$a^O \equiv argmax_a\{\pi_S^{RPP} - a\}$.

As before, S's investment is fully characterized by the first order condition that the investment's marginal benefit be equal to its marginal cost, that is:

$\beta'(a)\omega + \frac{1}{2}q'(a^O) = 1$.

This condition implies that S will choose a positive investment level, $a^O > 0$, which may be above or below the first best level depending on the value of M's resources.

As in the classic ICT model, the RPP model predicts that S will invest more, and hence create more value for M, under the open price format than under the closed price one: $a^O > a^C$. To see this, notice that for a given investment level a, S's marginal investment benefit is higher under an open price format because in addition to appropriating M's resources, S also appropriates (through bargaining) half of the gains from trade. Therefore, at the closed-price investment level a^C, S's marginal investment benefit under an open price format exceeds one, the marginal cost. Since S's marginal benefit is a concave function, and therefore decreaes in the investment level, this implies that in order to equate marginal benefit to marginal cost, S must increase its investment level above a^C.

At the same time, RPP generates sharply different predictions from classic ICT on the optimal choice of price format. Under ICT, the fact that a closed price format redues the component's value to M relative to an open price format implies that M and S will not include a closed price in their stage-1 contract. That is because, as discussed above, the component's value under open price is always lower than the surplus-maximizing level (due to the investment's non-contractibility) so if a closed price format further reduces the investment level it will also reduce the joint surplus and hence will be suboptimal. In contrast, under RPP, there is a region in which the open price format induces S to invest too much relative to the surplus-maximizing level. If ω, the value of M's appropriable resources, is high enough relative to the investment's value add, a closed price contract is optimal because it reduces wasteful investment costs more than it decreases value. That will occur, for instance, if ω is so large that S overinvests under both a closed price and an open price format. In that case, closed price is clearly optimal as it mitigates S's overinvestment.

H3: *In the RPP mode, (a) the supplier's dedicated investment under a closed-price format is smaller than under an open-price format ($a^C < a^O$); (b) the OEM's value add from incorporating the supplier's component into its end product under a closed-price format is smaller than under an open-price format ($q(a^C) < q(a^O)$); and (c) M and S will choose the closed price format over the open price format if and only if ω, the value of M's pre-existing resources, is high enough.*

EMPIRICAL STRATEGY

Empirical Context and Data Collection Procedure

We test our hypotheses in the context of industrial OEMs procuring from independent suppliers. We use data from a survey 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 first conducted.on-site, in-depth interviews with OEM purchasing managers. We used then the information 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. 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.[9]

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>

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, and to match our analytical model, we classified *closed-price formats* 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 formats thus preclude renegotiation and hence pre-determine the division of trade surplus over the contract period. In contrast, we classified *open-price formats* 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 fomats, 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 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

[9] 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.

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 Likert 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.

Our informants suggested that their agreements do not usually describe in detail the dedicated investments to be made by the supplier, due to the costs of specifying ex ante the component's production requirements. 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 suggest that consistent with the ICT theoretical framework, the supplier's dedicated investments are likely to be noncontractible in our context. This institutional characteristic of our setting, together with the fact that our TCE and ICT models generate competing predictions on he effect of price formats on dedicated investments, makes our setting particularly well suited to test the predictive power of the ICT approach relative to TCE.

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 include these variables, described below, as controls in our empirical analyses.

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 format 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 format. 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 formats 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 formats. Third, several papers adopting the TCE 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 formats to incentivize the supplier to keep production costs low. However, using such formal incentive may be less requisite if the parties expect to be in a long-term relationship and hence can rely on self-enforcing, relational agreements to sustain cooperation (e.g., Heide 1994; Kalnins and Mayer 2004; Corts and Singh 2004). To control for this possibility, we include in our estimations *Tenure*, which measures the length of the parties' relationship in number of years and has been used as a proxy for the expected future duration of the relationship, 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 (e.g., Poppo and Zhou 2014). 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; Kang et al. 2009). 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 models discussed above, we test our three sets of empirical hypotheses for a collaborating OEM-supplier dyad. Since contract form is an endogenous decision variable, simply regressing *Supplier's dedicated investment* (or its rank-ordered amounts) and *OEM's profitability* (or *end-product enhancement*) on *Price format* generates 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 endogeneity and hence examine the effects of price formats on dedicated investment (Maddala 1983; Wooldridge 2010, pp.948-951).[10] In particular, our empirical model is formulated as a system of the following two equations:

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[10] 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 our key variable of interest, price formats, in the outcome equation (8). See Miranda and Rabe-Hesketh (2006) and Woodridge (2010, Ch. 19) for detailed discussions.

(1) $$C_i^* = z_i'\alpha + \gamma\omega_i + v_i$$

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

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

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 (1), 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 pre-existing 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 (2), 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 for the instrumental variable – *Contract enforceability*. α, γ, λ, κ, and θ are coefficients to be estimated.

Enforceability of formal contractual terms is directly related to the choice of price format in the formal contract. At the same time, as discussed above, the supplier's dedicated investments and value creation do not appear to be part of formal OEM-supplier contracts in our setting. These facts make *Contract enforceability* a plausible instrumental variable for *Price format*.[11]

[11] 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 (1) and (2), which are thus solely identified by their nonlinear functional form. We obtain results that are qualitatively similar to those presented here.

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 (2). We estimate the endogenous switching regression of (1) and (2) 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.

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 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 H3(c), which hypothesizes

that the usage of closed prices (versus open prices) increases in the value of OEM pre-existing resources. In both regressions, higher *OEM market strength* increases the likelihood that closed-price contracts are adopted (column 1: $\gamma = 0.48$, and column 2: $\gamma = 0.53$). This result supports RPP. However, this result does not support TCE (hypothesis H1(c)) or classic ICT (hypothesis H2(c)), which always predict the closed price and open price format to be used, respectively.

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. This is consistent with the TCE's notion of adaptation need in uncertain environment. *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, $\alpha = 0.17$).[12] Effects of other control variables on price format are not statistically significant.

<u>Second-stage regressions on supplier's investment</u>*:* The effect of contract choice on supplier investment is shown in columns (1') and (2'), with *Supplier's dedicated investment* and its investment amount as the dependent variables, respectively. Our data provide support for both classic ICT's H2(a) and RPP's H3(a) but not TCE's H1(a). Specifically, we find that suppliers make

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

less dedicated investment under closed-price contracts than under open-price contracts (column 1': θ = -1.39, and column 2': θ = -1.72)[13].

After controlling for this key effect, *OEM market strength* and *OEM's relative size* are both positively correlated with supplier's investment, probably 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 focal supplier, the more the latter invests, although the positive coefficient of *Supplier irreplaceability* is only statistically significant in column (2').

Consistent with TCE and prior studies on inter-firm collaborations, governance mechanisms other than the price format also matter for suppliers' investment decisions (see Poppo and Zhou 2014 for reviews). 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.

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13 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 these results in the paper, but can provide them to interested readers upon request.

To summarize, results in Table 4 are fully consistent with the RPP model, partially consistent with the classic ICT model, and inconsistent with the TCE model. In other words, closed-price contracts in our data appear to be used to incentivize the supplier to make a noncontractible dedicated investment when OEMs have low-value pre-existing resources at stake, and to dis-incentivize the supplier from making suchg investment otherwise.[14]

<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. Here, *OEM's profitability* and *End-product enhancement* are the dependent variables in the outcome equations. The two sets of results are qualitatively similar. The statistics in Table 5 again show that: (i) price format cannot be treated as exogenous, and (ii) 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 shows support for ICT's H2(b) and RPP's H3(b) but not TCE's H1(b) (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. This sacrifice might have to do with

[14] 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, 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 will provide these results to interested readers upon resquest.

OEM's safeguarding their pre-existing resources that could be potentially be subject to guileful behavior by the supplier.[15]

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-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.

DISCUSSION

Theoretical frameworks like TCE and ICT, and the empirical work based on them, have predominantly focused on explicating the efficient design of governance forms to mitigate

[15] 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.

contractual hazards (e.g., incentivizing 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 explicitly impact governance design (Ghosh and John 1999; Nickerson et al. 2001; Madhok 2002; Zanarone et al. 2016). By integrating the issue of resources protection with ICT, the recent RPP approach tries to provide an understanding of value-generating governance forms when appropriable pre-existing resources are involved in inter-firm collaborations.

This paper analytically analyzes a given contractual relationship through the lenses of three stylized theoretical models – TCE, ICT, and RPP – and takes their distinctive hypotheses to 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. Our data show that a closed-price format is likely to be used when OEM's pre-existing resources are valuable, but has th cost of reducing the seller's incentives to invest and the value creation for the OEM. As such, our findings are fully consistent with RPP, partially consistent with ICT, but not consistent with TCE. The results suggest that OEMs design their contracts to strike a balance between the need to foster dedicated investment and value creation (satisfied by an open price format) and the need to protect their pre-existing resources from appropriation (satisfied by a closed price format).

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, 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 judicious about contract-format choices when the relationships involves pre-existing resources. Specifically, we suggest that using open-price contracts should balance: (a) their expected gains from the value-added investments and customization within the relationship with (b) their potential borne out of exposing their pre-existing resources to potentially opportunistic actions on the part of the supplier.

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 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, to fully test the RPP framework which receives the most support in our data, 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.

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WHY FIRMS MAKE UNILATERAL INVESTMENTS SPECIFIC TO OTHER FIRMS: THE CASE OF OEM SUPPLIERS
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MARKET FRICTIONS AS BUILDING BLOCKS OF AN ORGANIZATIONAL ECONOMICS APPROACH TO STRATEGIC MANAGEMENT
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Clearing a Path Through the Forest: A Meta-
Review of Interorganizational Relationships
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Figure 1. Timeline of events.

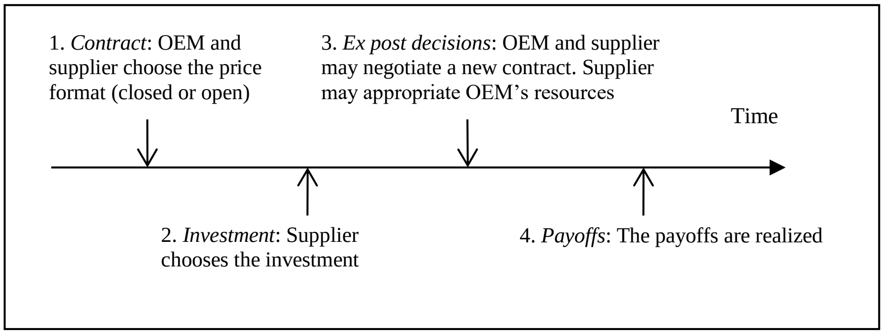

Table 2. Measures and descriptive statistics.

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	
Dependent variables	(1) ***Price format*** *Closed-price contract* = 1; *Open-price contract* = 0 (Probit)	(1') ***Supplier's dedicated investment*** (Ordered probit)	(2) ***Price format***: *Closed-price contract* = 1; *Open-price contract* = 0 (Probit)	(2') ***Amount of supplier's dedicated investment*** (Ordered probit)
Main Variables				
Price format		-1.39***		-1.72***
		(0.07)		(0.05)
		H_1(–)		**H_1(–)**
OEM product strength	0.48***	0.47***	0.53***	0.59***
	(0.14)	(0.03)	(0.13)	(0.02)
	H_3(+)		**H_3(+)**	
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	
Dependent variables	(1) ***Price format*** *Closed-price contract* = 1; *Open-price contract* = 0 (Probit)	(1') ***OEM end-product profitability*** (Ordered probit)	(2) ***Price format***: *Closed-price contract* = 1; *Open-price contract* = 0 (Probit)	(2') ***OEM end-product enhancement*** (Ordered probit)
<u>Main Variables</u>				
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(+)**	
<u>Other Variables</u>				
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*** (0.000)		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.