A Theory of Bargaining Costs and Price Terms in the Absence of Specific Investments

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Abstract

Firms often bring pre-existing capabilities such as brands and market strength into cooperative ventures. We model price terms in these ventures as a choice between ex ante design costs and ex post opportunism, in the shadow of judicial behavior. On the one hand, to save on design costs, parties can leave the price open for future negotiations. This will induce them to gather proprietary information during the venture's exploratory stage in the hope of using it as a bargaining chip. Eventually, the parties may prefer to use this information for actions that yield them private benefits but dilute the counterpart's capabilities, resulting in ex post inefficiencies. On the other hand, parties can incur the cost of specifying contract terms at the outset, thus preventing ex post bargaining through a credible threat of having those terms reinstated by courts. This reduces their incentives to gather information ex ante and, therefore, their ability to dilute each other's capabilities ex post. Consequently, firms will choose specific contracts when pre-existing capabilities are valuable and contract design costs are low. Our theory adds to Transaction Cost Economics by (1) formalizing in a novel way the idea that contracts reduce ex post inefficiencies and (2) showing that contracts also protect non-specific assets, such as firms' capabilities.

Keywords: Bargaining, Firm Capabilities, Contract Design, Opportunism, Pricing.

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1. Introduction

Coase (1937) argues that firms exist because transactions in the market are costly and emphasizes bargaining as a major source of such costs. Since then, much of Transaction Cost Economics (TCE) has presumed the existence of bargaining costs and proposed vertical integration and long-term contracts as alternative organization solutions (Klein et al. 1978; Williamson 1971, 1975). Despite the abundant evidence supporting the TCE predictions on governance choice,[1] the issue of how bargaining costs are generated and how contracts neutralize them are rarely formalized (e.g., Hart 2008, p.406). This paper joins an emerging stream of work that formalizes bargaining costs and how they affect contract forms (Masten 1988, 2009; Bajari and Tadelis 2001; Hart and Moore 2008), thus making progress on this agenda.

Consider a seller and a buyer who bring their pre-existing *generic* assets, such as engineering know-how and brand strength (hereafter, "capabilities") [2], in a trade and decide on whether to specify the price terms ex ante or leave them open. The buyer needs a good with both "hard", contractible features – for instance, engineering specifications -- and "soft, non-contractible features, such as suitable ergonomics. Importantly, the seller must exchange proprietary information with the buyer before starting production, in order to

[1] See Shelanski and Klein (1995) and Macher and Richman (2008) for surveys of empirical TCE.
[2] The Resource-Based View of the firm contends that firms bring in unique, heterogeneous capabilities to create value in their cooperative ventures (e.g., Wernerfelt 1984; Madhok and Pullman 1998).

discover how to deliver the good's "soft" features. Ex post, the parties may be able to use this information to dilute each other's capabilities, either for private benefit (opportunism) or as a threat to renegotiate the good's price (rent-seeking).[3] An example of rent-seeking would be the buyer threatening to badmouth the seller to prospective clients or to sue him over trivial non-performance issues, and the seller threatening to exploit loopholes in the contract and "work by the book", causing delays in the buyer's delivery to final customers. Examples of opportunism would be the seller revealing the buyer's trade secrets and technological weaknesses to competitors in exchange for money, using the acquired knowledge to set up his own brand and compete with the buyer (Arruñada and Vázquez 2006), or exploiting the good relations established with the buyer's key employees to escape controls and chisel quality (Anderson and Jap 2005). When the parties engage in opportunistic behavior, rather than merely threatening to do so for rent-seeking purposes, an *ex post inefficiency* arises.

We model price terms as a choice between ex ante design costs and ex post inefficiencies. By specifying price and other terms of the transaction ex ante, the parties incur contract design costs upfront even though the transaction may turn out to be inefficient ex post, due to fluctuations in demand and cost conditions. At the same time, fixing the contract terms ex ante prevents future price modifications because, absent verifiable changes in the good to be traded, courts would see those modifications as contrary to good faith and refuse to enforce them (Aivazian *et al*. 1984, Schwartz 1992). Anticipating that they won't be able to use it for rent-seeking purposes, Anticipating that they cannot to use it for rent-seeking purposes, the parties will then spend less effort in

[3] We borrow this terminology from Masten (1988).

collecting sensitive information ex ante and, therefore, become less able to dilute their counterpart's capability when chances for opportunistic uses of the information arise.. This leads us to predict that contracts with specified price terms ("specific contracts") will dominate non-specific ones when design costs are small, when the parties need to protect highly valuable capabilities from ex post dilution, and when the parties have frequent opportunities to engage in opportunistic behavior ex post. We view our approach as a model of bargaining *costs* because, although bargaining is efficient per se, the possibility of bargaining encourages excess information gathering ex ante, which can foster inefficient opportunistic actions ex post.

Our paper makes three main contributions to the literature on contracting. First, we extend classical Transaction Cost Economics, which focuses on the protection of specific assets from holdup as the main driver of alternative contract designs (Williamson 1979), to settings where the assets subject to holdup risks are *non-specific* (Lo et al 2011). Second, we show how the law of contract modification, whereby courts refuse to enforce modifications of price terms when the parties are locked into a bilateral monopoly and there are no substantial changes in the nature of the traded good (Aiviazian et al. 1984, Schwartz 1992), turns specific price provisions into a commitment device against post-contractual opportunism. Last but of potential greatest interests, we envision a novel way to model bargaining costs, which blends elements studied in isolation in previous works. Specifically, we combine the property-rights theory of incomplete contracts (Grossman and Hart 1986; Hart and Moore 1990), which emphasizes the distortionary effect of efficient ex post bargaining on ex ante incentives, with the more recent adaptation theories, which emphasize the difficulty of contracting certain decisions, even ex post (Gibbons 2005;

Baker et al. 2010). As in the property-rights theory, we model non-contractible actions (information gathering) and contractible decisions (price, trade and the good's "hard" characteristics). As in the adaptation theory, we also model non-contractible decisions (the good's "soft" characteristics and the parties' ex post opportunistic behavior). We link the two frameworks by showing how ex ante non-contractible efforts in information gathering, which are incentivized by the future prospect of bargaining over contractible price and trade decisions, also induce the parties to choose opportunistic actions ex post.

Our modeling on bargaining costs differs from, and yet complements recent formal models of ex post inefficiencies in contracts, such as Bajari and Tadelis (2001), Masten (1988, 2009), and Hart and Moore (2008). While Bajari and Tadelis (2001) model ex post inefficiencies as negotiation breakdowns, we show that they may also arise because of hostile, but privately beneficial opportunistic behaviors like those described at the beginning of this paper (see also Goldberg 1985 and Masten 1988). Importantly, our rationale for fixed-price contracts, and thus its relationship with ex post inefficiencies, is opposite to that in Bajari and Tadelis (2001). In Bajari and Tadelis (2001), fixed-price contracts improve the seller's ex ante incentives for cost-cutting effort but, at the same time, they *exacerbate* ex post inefficiencies by inducing parties to bargain more aggressively. Conversely, in our model, fixed-price contracts *reduce* ex post inefficiencies by preventing opportunistic renegotiations and, consequently, reducing the parties' ex ante incentives to gather information that may be used for inefficient, opportunistic purposes ex post. This difference in the role of price terms stems from the different contractual environments studied in the two models. In Bajari and Talides (2001), the *contractible* features of the good to be exchanged are *uncertain* ex ante. Conversely, those features are

fixed in our model – the only uncertainty being on demand and cost conditions. Since we assume courts only enforce *substantive* contractual renegotiations – those changing the nature of the good – but not *redistributive* renegotiations – those where the contractible nature of the good is fixed and only the price changes – specifying price ex ante commits the parties to the price in our model, but not in Bajari and Tadelis (2001). An apparent similarity between the two models is the prediction that "product complexity" disfavors fixed-price contracts. However, the similarity is purely semantic. Bajari and Tadelis (2001) define complexity as the degree of ex ante uncertainty on the good's contractible features, which is zero in our model. Instead, we define complexity as richness in the good's contractible features. According to this definition, a good may be complex and costly to contract even when there are no future contingencies to describe (Battigalli and Maggi 2002). We believe that both types of complexity are empirically relevant and, therefore, we see our model of price terms as complementary to Bajari and Tadelis (2001).

Masten (1988, 2009) models bargaining costs as wasteful rent-seeking activities. However, it is unclear why informed parties in his models cannot seal their contracts immediately after uncertainty is resolved and thus prevent rent-seeking behavior (Hart 2008). Our model is robust to this criticism, because the capacity to threaten/ harm one's counterpart is acquired during information gathering and thus the related costs sunk when uncertainty over the state of the world has not yet been resolved. Therefore, the parties have no incentives, ex post, to "rush" to seal their contract. Rather, each party has an incentive to exploit his harming capacity to pursue private benefits.

Finally, in Hart and Moore (2008), contracting parties negotiate price terms in a competitive market and use the initial contract as a reference point to determine how much

they can expect to gain from renegotiations after they are locked into a bilateral monopoly. A party who does not obtain what she expects from ex post negotiations will feel aggrieved and retaliate against the other by withdrawing non-contractible performance. This generates a tradeoff between rigid contracts, which allow for one or few possible prices for trade and thus minimize aggrievement and wasteful haggling at the cost of preventing efficient trade in some states, and flexible contracts, which insure trade in more states at the cost of increasing aggrievement and haggling due to more frequent negotiations. We show that, even without relying on the behavioral assumption that contracts are reference points for future negotiations, our two-stage bargaining approach, in conjunction with the legal reinstatement doctrine, can deliver a tractable model of ex post inefficiencies and explain many business contracts observed in reality.

The rest of this paper is organized as follows. Section 2 presents our theoretical model. Section 3 describes its results. Section 4 discusses empirical and casuistic evidence. Section 5 concludes.

2. The Model

A buyer (B) and a seller (S), both risk-neutral, are about to start a joint venture to produce a good. Both B and S bring to the joint venture their pre-existing capabilities. These capabilities, such as superior engineering design or constituent brand strength, are unique to the respective contracting party. However, they are *non-specific*, since they can be used to produce goods outside the focal relationship, and the value of such goods is

independent of whether they are produced by B and S together or by each with a third party. We denote the values of B's and S's pre-existing capabilities as ω_B and ω_S respectively. We assume that the joint venture follows these stages:

1. *Contracting*: B and S decide whether to join their pre-existing capabilities to produce a good with certain contractible, "hard" characteristics. If they do so, they sign a contract (t_c, p_c), where $t_c \in \{0,1\}$ denotes the decision on whether to trade the good or not ($t_c = 1$ means trade), and $p_c \in \mathbb{R}$ denotes the price to be paid from B to S upon delivery;

2. *Information gathering*: B and S meet before starting production and simultaneously choose information-gathering efforts $a_B \in \mathbb{R}^+$ and $a_S \in \mathbb{R}^+$, respectively. Party i incurs an immediate cost $L_i(a_i)$ by spending effort a_i;

3. *State realization*: B and S observe the state of the world $k = \left(V_k, C_k, \pi_{ik}(a_i), \alpha_{ik}(a_j)\right)$, drawn with probability q_k from the finite set K, where V_k denotes the value of the jointly-produced good to B, C_k is the production cost to S, and $\pi_{ik}(a_i)$ and $\alpha_{ik}(a_j)$ will be defined momentarily;

4. *Bargaining and hostile behavior*: B and S may negotiate via Nash bargaining a new contract (t_k, p_k). Moreover, party i chooses the decision $h_{ik} \in \{0,1\}$, where $h_{ik} = 1$ denotes that party i harms party j in state k.[4] If $h_{ik} = 1$, party i obtains a payoff

[4] Harm may take different forms in different states. Formally, this implies that $h_{ik} \neq h_{is}$ for some $k \neq s$.

$\pi_{ik}(a_i) \geq 0$ and causes a dilution $\alpha_{jk}(a_i)\omega_j$ in the value of party j's capability, where $\alpha_{jk}(\cdot) \in [0,1]$ for any j and k;

5. *Implementation*: If B and S trade at price p_k, B receives the payoff $V_k - p_k$ (gross of any contract design costs), and S receives $p_k - C_k$. If B and S do not trade, B receives b_k and S receives s_k.

6. *Litigation*: If B and S have renegotiated at stage 4 and $t_k = t_c$ but $p_k \neq p_c$, the party who has lost from renegotiation may claim that p_k has been extracted under duress and ask a judge to reinstate p_c. The judge observes a vector ξ of characteristics of B, S, their contract, and the competitive environment in their industries, where $\xi_i \in \mathbb{R}$ for any element of ξ. After observing ξ, the judge chooses decision $r \in \{0,1\}$, where $r = 1$ denotes that the judge reinstates the stage-1 price p_c.

Discussion of the timing

At stage 2, each party acquires information that can potentially harm his partner at the later stage 4. For example, an original equipment manufacturer may acquire proprietary information on its component supplier's products, and later use this to negotiate a better price after the project's value is realized. Alternatively, the party may simply collect evidence on his partner's hidden competitive weaknesses ex ante, which would allow him to sue for damages or obtain favors from the latter's competitors. Since the cost of information gathering is sunk ex ante, ex post inefficiencies may arise when the private

benefits of opportunistic behavior are so high that the party actually prefers to harm his counterpart.

Two important assumptions are implicit in the model's timing. First, B and S must exchange information at stage 2, even though they both know the information may be used against them ex post. To rationalize this assumption, think of it as a reduced form for a richer model where the good to be traded has both a "hard", contractible feature t and a "soft", non-contractible feature s, which is necessary to insure a good fit between the good and B's needs. Let $t \in \{0,1\}$ and $s \in \{0,1\}$ be dummies for whether characteristics t and s are present, respectively. Let $f \in \{0,1\}$ be a dummy for whether the good fits B's needs, and assume f is contractible and that f = 1 if, and only if t = 1 and s =1 – that is, characteristics s and t are both essential for fit. Given these assumptions, it is natural to interpret a contract specifying trade ($t_c = 1$) as one where t = 1 and f =1. Suppose, last, that, while both B and S know t at stage 1, they ignore s, and that, in order for S to learn how to deliver s, B and S must spend efforts a_B^* and a_S^* in passing information to each other – for instance, a_B^* and a_S^* may describe an exchange of documents or a visit of S's employees to B's plant. Normalize a_B^* and a_S^* to $\varepsilon \approx 0$ and say that B and S "meet" if $a_B \geq a_B^*$ and $a_S \geq a_S^*$. B and S will meet in equilibrium – that is, there must be a stage 2 in the model – because meeting is essential for trade to occur. Hence, we can interpret decisions a_B and a_S at stage 2 as *excess efforts* in information gathering that arise when B and S meet. We leave for future work an extension of the model to the case where the non-contractible

feature s is not essential, so effort levels $a_B > a_B^*$ and $a_S > a_S^*$ may be efficient but not feasible.

The second implicit assumption in the model's timing is that parties cannot harm each other (perhaps out of spite) after the initial contract has been reinstated at stage 6. If that were possible, given that harm is costless ex post, the threat of suing redistributive contractual modifications would not be credible, so specifying the price ex ante would not help. We find this assumption reasonable, for two reasons. First, retaliation activities such as "working by the book" simply cannot be carried once the good has been produced. Second, there are retaliation activities whose effect may be severely diminished after a successful reinstatement lawsuit: for instance, it may be hard for an OEM to badmouth his supplier and be believed if the receivers of his messages know that the OEM just lost a lawsuit with the supplier on contractual matters, and even more so if the lawsuit was about reinstatement, which signals strong OEM's opportunism.

Additional assumptions

The model rests on the following additional assumptions:

1) Trade is contractible at cost D;

2) $V_k - C_k \geq b_k + s_k$ for every $k \in K$;

3) There is a subset of states $K_T \subset K$ such that $V_k - b_k < s_k + C_k + D$ for $k \notin K_T$;

4) $\sum_{k \in K} q_k \left(V_k - b_k\right) = E_{k \in K}\left[V_k - b_k\right] > E_{k \in K}\left[s_k + C_k + D\right] = \sum_{k \in K} q_k \left[s_k + C_k + D\right]$;

5) For any $i \in \{B,S\}$, there is a subset of states $K_H \subset K_T$ such that $\pi_{ik}(a_i) > 0$ for $k \in K_H$ and $a_i > 0$, while $\pi_{ik}(a_i) = 0$ for $k \notin K_H$;

6) For any i, j and k: π_{ik} and α_{ik} are increasing and concave, L_i is increasing and convex, $\pi_{ik}(0) = \pi'_{ik}(0) = \alpha_{ik}(0) = \alpha'_{ik}(0) = 0$, and $\lim_{a_i \to \infty} \alpha_{jk}(a_i) = 1$;

7) $\alpha_{jk}(a_i)\omega_j > \pi_{ik}(a_i)$, for any $k \in K$ and $i, j \in \{B,S\}$;

8) a_i, h_{ik}, V_k, C_k, $\pi_{ik}(a_i)$, $\alpha_{ik}(a_j)$ and ω_i are non-verifiable for any $i \in \{B,S\}$;

9) The judge's utility from reinstating the original contract in state k is $U_{Jk} = \left(r - \frac{1}{2}\right)(2LI_k - 1)$, where $LI_k \in \{0,1\}$ is an indicator for whether the judge deems it a bilateral monopoly in which B or S are locked into and therefore exposed to holdup. Specifically, $LI_k = 1$ when $V_k - C_k - b_k - s_k \geq LI^*$, where LI^* is the judge's tolerance of holdup.

10) $\frac{d\ \mathrm{Prob}(LI_k = 1 | \xi)}{d\xi} > 0$

In line with the incomplete contracts literature, Assumption 1 implies that writing a contract that describes performance metrics, product specifications, and responsibilities is costly: business partners often spend significant efforts in drafting, communicating, interpreting, and recording their agreements. This is true even when contracts are in standardized format (e.g., Ben-Shahar and White 2005, in particular p.18). Assumptions 2 and 3 imply that, although trade always produces a net value (assumption 2), there are

states where this value is not high enough to make the contract design costs worthwhile (assumption 3). Assumption 4 implies that in expectation trade is efficient. Assumption 5 implies that there are states where a party benefits directly from harming the other ($\pi_{ik}(a_i) > 0$), and states where she benefits indirectly by threatening to harm in order to negotiate on better terms ($\pi_{ik}(a_i) = 0$ but $\alpha_{jk}(a_i) > 0$ for $a_i > 0$). The former are *opportunism* states, the latter are *rent-seeking* states.[5] For instance, a component supplier may leak his OEM's proprietary information to the latter's competitors to gain favors (e.g., Myers and Cheung 2008, p.69), or threaten to do so in order to extract more surplus from bargaining (e.g. Lyons et al. 1990, p.34). Assumption 6 implies that, when an opportunity to harm arises ex post, it can only be exploited if the parties have gathered information ex ante, and that harm becomes more effective the greater the information-gathering effort. Assumption 7 implies that harm is ex post inefficient even in states where it produces private benefits. Assumption 8 implies that contracts are incomplete, in the sense that B and S cannot directly or indirectly agree not to engage in wasteful information-gathering and not to harm each other ex post. Assumption 9 captures an important legal principle on contract modifications: when two parties are locked-in ex post, courts presume that purely redistributive modifications of their original contract have been extorted under economic duress, and are willing to reinstate the original contract on demand (Aivazian et al. 1984; Schwartz 1992; Schwartz and Scott 2003). Two features of the judge's utility function are

[5] We assume that, once a capacity to harm has been acquired ex ante, inflicting harm is costless ex post. We would obtain similar results if we assumed that the cost of inflicting harm ex post is small relative to its benefit. In states that belong to K_H, the benefit of harm is given by $\pi_{ik}(\cdot)$ whereas, in states that do not belong to K_H, this benefit may be given by the private satisfaction to retaliate against a party who refuses to negotiate.

noteworthy: first, it is symmetric, in the sense that the judge receives the same (dis)utility from making the right (wrong) decision. Second, the judge is only willing to reinstate the original contract if the degree of lock-in between B and S – and the consequent risk of holdup – exceeds a threshold. This threshold may be established by law, or it may reflect the judge's personal concern with the redistributive consequences of holdup. Assumption 10 complements Assumption 9, implying that, while the judge does not observe whether B and S are locked-in, he observes *signals* of lock-in – for instance, the importance of *contractible* specific investments, geographic proximity, or simply temporal specificity, defined as the parties' ability to promptly find alternative partners in the spot market (Masten et al. 1991). As we will shortly see, the assumptions on judicial reinstatement are important because they insure that, despite contractual incompleteness, the parties can *indirectly* commit not to engage in wasteful renegotiations ex post by specifying their price terms ex ante.

3. The choice of contract form

This section considers in turn the benefits and costs of writing a specific versus non-specific contract at stage 1.

Specific contract

Consider the case where, at stage 1, B and S agree on a specific contract $(t_c = 1, p_c)$, incurring the design cost D. Without loss of generality, we assume D is paid by the buyer.

To evaluate the joint surplus under this contract, we proceed by backward induction. Given that the design cost has already been sunk and that $V_k > C_k$ in each state, B and S will always want to trade at stage 4. In addition, if $a_i > 0$ and $k \in K_H$, party i will harm party j. If $a_i > 0$ but $k \notin K_H$, party i may threaten to harm j in case j refuses to renegotiate the price to $p_k \neq p_c$. Suppose B and S have renegotiated the price at stage 4. Then, the party who loses from renegotiation can take his case to the court at stage 6 and ask the judge to reinstate the initial price p_c[6]. The judge will choose the reinstatement decision r to solve

$$\max_r E_k\left[U_{Jk}\middle|\xi\right] = \left(r - \frac{1}{2}\right) E_k\left[2LI_k - 1\middle|\xi\right] = \left(r - \frac{1}{2}\right)\left[2\text{Prob}\left(LI_k = 1\middle|\xi\right) - 1\right]. \qquad (1)$$

Hence, the judge will set r = 1 if, and only if $\text{Prob}\left(LI_k = 1\middle|\xi\right) \geq \frac{1}{2}$.

Assume, first, that $\text{Prob}\left(LI_k = 1\middle|\xi\right) \geq \frac{1}{2}$, so the judge reinstates the initial contract at stage 6. Then, B and S do not even bother to renegotiate the price at stage 4. Anticipating that, B and S will choose the information-gathering efforts at stage 2 to solve, respectively:

$$\max_{a_B} E_{k\in K_H}\left[V_k + \pi_{Bk}(a_B) - p_c + \left(1 - \alpha_{Bk}(a_S)\right)\omega_B\right] + E_{k\notin K_H}\left[V_k - p_c + \omega_B\right] \text{ and}$$

$$\max_{a_S} E_{k\in K_H}\left[p_c - C_k + \pi_{Sk}(a_S) + \left(1 - \alpha_{Sk}(a_B)\right)\omega_S\right] + E_{k\notin K_H}\left[p_c - C_k + \omega_S\right].$$

The parties' efforts, denoted as a_B^{SC} and a_S^{SC}, are then given by the first-order conditions

[6] We implicitly assume that retaliation opportunities no longer exist after stage 5.

$$\sum_{k\in K_H} q_k \pi'_{Bk}(a_B) = L'_B(a_B) \text{ and} \quad (2)$$

$$\sum_{k\in K_H} q_k \pi'_{Bk}(a_B) = L'_B(a_B). \quad (3)$$

Hence, at stage 1, the expected joint surplus under a specific contract is

$$JS^{SC} = E_{k\in K}\left\{V_k - C_k - D + \sum_i \omega_i\right\} - E_{k\in K_H}\left\{\sum_i\left[\alpha_{ik}\left(a_j^{SC}\right)\omega_i - \pi_{ik}\left(a_i^{SC}\right)\right]\right\} - \sum_i L_i\left(a_i^{SC}\right).$$

Assume, instead, that $\text{Prob}\left(LI_k = 1|\xi\right) < \frac{1}{2}$. Then, the judge will not reinstate the original contract at stage 6, so the analysis of specific contracts coincides with that of non-specific contracts, to which we now turn.

Non-specific contract

Consider the case where B and S wait to contract after state is realized. In this case, if B and S negotiate a contract (t_k, p_k) at stage 4, no party can seek judicial reinstatement at stage 6 because there is no previous contract to reinstate. When $k \notin K_T$ that is, when contracting is inefficient, there will be no negotiation, no trade, and no harm; B and S's payoff will be $b_k + \omega_B$ and $s_k + \omega_S$ respectively. Conversely, when $k \in K_T$, negotiation will occur. Assume S has bargaining power γ and B has bargaining power $(1-\gamma)$. Then, the price B and S negotiate, p_k, depends on whether $k \in K_H$ or not. Suppose, first, that $k \in K_H$. Since party i obtains a private benefit $\pi_{ik}(a_i) > 0$ and the decision to harm, h_{ik}, is non-contractible, both parties harm each other in equilibrium. B's payoff from bargaining is

$$\left(1-\alpha_{Bk}\left(a_S\right)\right)\omega_B+\pi_{Bk}\left(a_B\right)+V_k-p_k-D$$

and S's payoff is

$$\left(1-\alpha_{Sk}\left(a_B\right)\right)\omega_S+\pi_{Sk}\left(a_S\right)+p_k-C_k.$$

Assuming that B and S agree to the Nash Bargaining Solution, B's payoff must be equal to

$$b_k+\left(1-\alpha_{Bk}\left(a_S\right)\right)\omega_B+\pi_{Bk}\left(a_B\right)+\left(1-\gamma\right)\left(V_k-C_k-D-b_k-s_k\right)$$

and S's payoff must be equal to

$$s_k+\left(1-\alpha_{Sk}\left(a_B\right)\right)\omega_S+\pi_{Sk}\left(a_S\right)+\gamma\left(V_k-C_k-D-b_k-s_k\right).$$

In words, each party receives his payoff under his outside option plus a share of the net bargaining surplus between trade and no trade. Solving from the above equations, we obtain the price

$$p_k^H=\gamma\left(V_k-D-b_k\right)+\left(1-\gamma\right)\left(C_k+s_k\right). \qquad (4)$$

Suppose, now, that $k\in K_T$ but $k\notin K_H$. In this case, each party harms the other only if the other party refuses to negotiate, so capabilities are not diluted in equilibrium. However, the threat of dilution serves as a bargaining chip. B's payoff from bargaining is

$$\omega_B+V_k-D-p_k,$$

and S's payoff is

$$\omega_S+p_k-C_k.$$

Under Nash Bargaining, B's payoff must also be equal to

$$b_k + \left(1-\alpha_{Bk}\left(a_S\right)\right)\omega_B + \left(1-\gamma\right)\left[\sum_{i\neq j}\alpha_{ik}\left(a_j\right)\omega_i + V_k - C_k - D - b_k - s_k\right],$$

and S's payoff must be equal to

$$s_k + \left(1-\alpha_{Sk}\left(a_B\right)\right)\omega_S + \gamma\left[\sum_{i\neq j}\alpha_{ik}\left(a_j\right)\omega_i + V_k - C_k - D - b_k - s_k\right].$$

Solving from the above equations, we obtain the price

$$p_k^{NH}(a_B, a_S) = \gamma\left[V_k - D - b_k + \alpha_{Bk}\left(a_S\right)\omega_B\right] + \left(1-\gamma\right)\left[C_k + s_k - \alpha_{Sk}\left(a_B\right)\omega_S\right]. \qquad (5)$$

Anticipating this outcome, B chooses their information-gathering efforts at stage 2 to solve, respectively,

$$\max_{a_B}\left\{\begin{array}{l} E_{k\in K_H}\left[V_k - D - p_k^H + \pi_{Bk}\left(a_B\right) + \left(1-\alpha_{Bk}\left(a_S\right)\right)\omega_B\right] + E_{\substack{k\in K_T \\ k\notin K_H}}\left[V_k - D - p_k^{NH}\left(a_B, a_S\right) + \omega_B\right] + \\ + E_{k\notin K_T}\left[b_k + \omega_k\right] - L_B\left(a_B\right) \end{array}\right\}$$

and

$$\max_{a_S}\left\{\begin{array}{l} E_{k\in K_H}\left[p_k^H - C_k + \pi_{Sk}\left(a_S\right) + \left(1-\alpha_{SK}\left(a_B\right)\right)\omega_S\right] + \\ + E_{\substack{k\in K_T \\ k\notin K_H}}\left[p_k^{NH}\left(a_B, a_S\right) - C_k + \omega_S\right] + E_{k\notin K_T}\left[s_k + \omega_S\right] - L_S\left(a_S\right) \end{array}\right\}.$$

The solutions, denoted as a_B^{NSC} and a_S^{NSC}, are given by the first-order conditions

$$\sum_{k\in K_H} q_k \pi_{Bk}^{'}\left(a_B\right) + \sum_{\substack{k\notin K_H \\ k\in K_T}} q_k\left(1-\gamma\right)\alpha_{Sk}^{'}\left(a_B\right)\omega_S = L_B^{'}\left(a_B\right), \text{ and} \qquad (6)$$

$$\sum_{k\in K_H} q_k \pi_{Sk}^{'}\left(a_S\right) + \sum_{\substack{k\notin K_H \\ k\in K_T}} q_k \gamma \alpha_{Bk}^{'}\left(a_S\right)\omega_B = L_S^{'}\left(a_S\right). \qquad (7)$$

By comparison of (2) with (6) and of (3) with (7), it immediately follows that

Proposition 1: $a_i^{NSC} > a_i^{SC}$ and $\alpha_{jk}\left(a_i^{NSC}\right)\omega_i - \pi_{ik}\left(a_i^{NSC}\right) > \alpha_{jk}\left(a_i^{SC}\right)\omega_i - \pi_{ik}\left(a_i^{SC}\right)$, for any i.

Under both specific and non-specific contracts, gathering information ex ante generates returns when opportunities for opportunistic behavior arise. Under non-specific contracts, gathering information has the additional advantage of increasing the parties' ability to use the threat of hostile behavior to negotiate prices ex post. This additional return on information-gathering does not arise under specific contracts, because the threat of judicial reinstatement prevents ex post bargaining. As a result, both excess information-gathering and the resulting ex post inefficiencies can be reduced by fixing the price ex ante.

Given the above analysis, the joint surplus under a non-specific contract is

$$JS^{NSC} = E_{k\in K_T}\left[V_k - C_k - D\right] - E_{k\in K_H}\left[\sum_i\left(\alpha_{jk}\left(a_i^{NSC}\right)\omega_i - \pi_{ik}\left(a_i^{NSC}\right)\right)\right] + \sum_i \omega_i - \sum_i L_i\left(a_i^{NSC}\right).$$

Comparative analysis

At stage 1, B and S compare their expected payoffs under a specific versus a non-specific contract. Because of symmetric information, they will agree on the option that yields the greatest expected joint surplus and on a price that splits the expected surplus according to the parties' bargaining power, defined by γ.

From the previous analysis, it follows that a specific contract is efficient if, and only if $JS^{SC} > JS^{NSC}$. After simplifying and rearranging, this boils down to

$$\begin{aligned} &E_{k\in K_H}\left[\sum_i\left(\left(\alpha_{ik}\left(a_j^{NSC}\right) - \alpha_{ik}\left(a_j^{SC}\right)\right)\omega_i - \left(\pi_{ik}\left(a_i^{NSC}\right) - \pi_{ik}\left(a_i^{SC}\right)\right)\right)\right] + \\ &+\sum_i\left[L_i\left(a_i^{NSC}\right) - L_i\left(a_i^{SC}\right)\right] > E_{k\notin K_T}\left[D - \left(V_k - C_k\right)\right]. \end{aligned} \qquad (8)$$

This can be summarized through the following proposition.

Proposition 2: A specific contract is efficient when the total cost of excess information-gathering (the term $\sum_i \left[L_i\left(a_i^{NSC}\right) - L_i\left(a_i^{SC}\right) \right]$) is large; when the expected ex post inefficiencies (the term $E_{k \in K_H}\left[\sum_i \left(\left(\alpha_{ik}\left(a_j^{NSC}\right) - \alpha_{ik}\left(a_j^{SC}\right) \right) \omega_i - \left(\pi_{ik}\left(a_i^{NSC}\right) - \pi_{ik}\left(a_i^{SC}\right) \right) \right) \right]$) are large; and when the expected cost from excessive contract design (the term $E_{k \notin K_T}\left[D - \left(V_k - C_k \right) \right]$) is small.

By inspection of (8), we obtain the following corollary of Proposition 2.

Corollary: A specific contract becomes more efficient as i) D decreases; ii) the set K_T increases; iii) the set K_H increases; and iv) ω_i increases, for any i.

In words, the parties prefer a specific contract when describing the content of trade in advance is relatively simple (part i), there are few states where the cost of describing trade in advance is large relative to the value of trade (part ii), there are several states where parties have an opportunity to profit from hostile behavior (part iii), and the parties' pre-contractual capabilities are valuable (part iv). In terms of the TCE literature, we may view parts (i) and (ii) as predictions on product complexity, and part (iii) as a prediction on the extent of ex post opportunism. Part (iv) is a novelty from our model, as it states that, even if assets are *non-specific* at the beginning of the contractual relationship, parties will safeguard them through tighter price terms.

Asset specificity and lock-in

While traditional TCE studies long-term contract as means to protect specific assets from holdup, it does not predict a relation between asset specificity and the precision of

price terms. Our model does predict a positive relation between specific contracts and factors that lock B and S into a bilateral monopoly situation, such as asset specificity (Williamson 1979), and temporal specificity (Masten et al. 1991)[7], as follows.

Proposition 3: Specific contracts are only observed when ξ is large. Moreover, an increase in ξ makes specific contracts more efficient, provided that D is small, or $\text{Prob}\left(k \notin K_T\right) = \sum_{k \notin K_T} q_k$ is small, or $\text{Prob}\left(k \in K_H\right) = \sum_{k \in K_H} q_k$ is large, or ω_i is large, for any i.

Proof: From (1) and from Proposition 1, we know that, when $\text{Prob}\left(LI_k = 1 \middle| \xi\right) < \frac{1}{2}$, $JS^{SC} < JS^{NSC} = JS^{SC} + E_{k \notin K_T}\left[D - \left(V_k - C_k\right)\right]$. Hence, specific contracts will only be observed when $\text{Prob}\left(LI_k = 1 \middle| \xi\right) \geq \frac{1}{2}$. Since $\text{Prob}\left(LI_k = 1 \middle| \xi\right)$ increases in ξ, this is the same as saying that specific contracts will only be observed when ξ is large. Assume that ξ is large. Then, specific contracts will be observed if, and only if (8) holds – that is, if D is small, or $\text{Prob}\left(k \notin K_T\right)$ is small, or $\text{Prob}\left(k \in K_H\right)$ is large, or ω_i is large, for any i. QED.

The intuition behind proposition 3 is simple: specific contracts reduce ex ante information-gathering and ex post dilution of the parties' capabilities only when they prevent renegotiation of the initial contract – that is, when they are backed by a credible threat of judicial reinstatement. In turn, courts refuse to enforce renegotiated contracts only when they believe that the parties are locked into a bilateral monopoly and, therefore,

[7] This seems an appealing feature of our model. Gibbons (2010) noted that, while most of the empirical TCE focuses on vertical integration and contracts as means to protect specific assets from holdup, theoretical TCE relies on the more general concept of bilateral lock-in, which could arise even in the absence of specific assets.

renegotiations are a product of holdup. Courts cannot observe the parties' degree of lock-in directly, but they can observe some signals of it, such as the size of the parties' contractible specific investments or the thickness of the market where they conduct their transactions. Hence, specific contracts help only when there are observable signals that the parties are locked-in; that is, when assets used in production are specific or, more generally, when it is difficult for the parties to promptly replace each other.

Note the difference between our argument and standard TCE. There, specific assets and lock-in are part of the problem: the more locked-in the parties are, the more they can threaten each other, and the greater the losses they suffer when the contractual relation fails. Here, lock-in is part of the solution. Parties acquire sensible information ex ante and use it as a bargaining chip ex post but, occasionally, the opportunistic use of such information becomes too tempting and the parties' reputation and brand-strength will get diluted. Dilution affects assets that are readily re-deployable outside the relation, so it does not depend, per se, on the degree of lock-in between the parties. However, when the parties are perceived by courts as being locked-in, they can use fixed-price contracts as credible non-renegotiation commitments and, by eliminating ex post negotiation, they can reduce their own ex ante incentives to gather information that can later be used opportunistically.

One last point pertains to testability. At first sight, proposition 3 seems inconsistent with evidence from the TCE literature, which shows that asset specificity increases contract duration (Joskow 1987, Crocker and Masten 1988) and, in turn, contract duration increases

uncertainty, calling for more flexible price terms (Crocker and Reynolds 1993).[8] However, the contradiction is only apparent, because proposition 3 holds contract duration as constant.[9] Indeed, by assuming that trade is perfectly contractible ex ante, we implicitly focus on an environment with moderate environmental uncertainty and, therefore, moderate contract duration. It would be interesting to see evidence on the relation between asset specificity, lock-in and the rigidity/flexibility of price terms, controlling for contract duration. We hope to pursue this goal in future work on this topic.

4. Evidence

Our model yields two main results. First, there is a tradeoff between fixing the price terms ex ante to prevent ex post *dilution of non- specific capabilities* and leaving the price terms open to save on ex ante contract-design costs. Second, specifying the price terms ex ante is useful when the parties are *perceived* to be locked into a bilateral monopoly, as a consequence of asset specificity *or other factors*. We emphasize that price terms in our model can be interpreted broadly as any contractual terms and conditions that define the division of trade surplus.

Our predictions are supported by both empirical studies and anecdotal evidence on vertical relationships such as aircraft engine procurement, construction contracts, and supplier-manufacturer contracts (including car manufacturing and co-branding agreements). We summarize these findings by first looking at the effect of pre-existing, non-specific

[8] But see Joskow (1988), who finds that long-term coal supply contracts use price escalation formulae that link price adjustments to objective, exogenous market variables such as market prices and costs, rather than to the outcome of negotiations between the parties. This seems to be in the spirit of our model, which could be easily extended to the case where specific contracts set a price formula, rather than a fixed price.
[9] We are grateful to Scott Masten for pointing this out to us.

capabilities on price and other contract terms, and then at the effect of ex post opportunism, and transaction uncertainty and complexity.

Protection of non-specific capabilities

Lo et al. (2011) find that in branded-component agreements, where a component is incorporated in and *co-branded* with the end-product, the stronger the brand strength of the component-supplier and the market strength of the OEM are, the more rigid the price format the parties use. The authors argue that these rigid price terms prevent rents created by the parties' pre-contractual, non-specific capabilities from being dissipated ex post.

To explain the observation that, while Japanese automobile manufacturers use long-term informal contracts with suppliers, their American counterparts mostly use arm's length formal contracts, Helper and Levin (1992) invoke the presence of large market power of US manufacturers in the 1910-29 period and in the 1950s – a measure of the value of auto-manufacturers' oligopoly rents (p.565-7) as the cause. Specifically, they argue that the non-verifiable nature of an auto-manufacturer's product-market rents would expose him to ex post appropriation by an opportunistic auto-part supplier *after* the two parties are transformed into a bilateral monopoly.

In the industrial-machine manufacturing sector, Ghosh and John (2005) find that, possibly due to opportunistic appropriation, less synergy (in terms of product enhancement) is created between the suppliers' inputs and the OEMs' final product when the OEM enjoys high reputation and premium pricing.

Interestingly, protecting pre-contractual, non-specific assets from ex post appropriation is also observed in marriage agreements. Mastron (1997, pp.891-892) observes that women bringing in high-value tangible assets and the parties who wish to protect their assets for their children from previous marriages are more likely to seek safeguards in the form of prenuptial agreements. Hamilton (1999, p.72) notes similar evidence in 19th-century Quebec where one in every six couples used prenuptial agreements. Using archival data, she finds that these "non-conventional" marriage agreements were more frequently used by men who had attractive outside options, e.g., the literate class and well-to-do merchants (p.89), and who married widows with children from their previous marriages.

Ex post opportunism

Our model predicts that the greater the risk of ex post opportunism through positioning and retaliation (formally, the greater the set K_H), the more we should observe contracts that specify the price in advance. Consistent with this prediction, Crocker and Reynolds (1993) find that the price terms in air-force procurement contracts are more rigid when the engine manufacturer has a past record of judicial disputes and, therefore, is likely to be opportunistic. In contracts between information-technology suppliers and auto manufacturers, Ben-Shahar and White (2005, p.13 and p.35-6) find that the former successfully negotiate more customized terms, including protective price terms, in order to safeguard their easy-to-abuse intellectual property.

In addition, the legal literature on relational contracts offers descriptions of opportunistic conducts such as threats of non-performance, lawsuits following minor faults,

working to rules, and post-agreement jockeying that plague real-world contractual relations (see Goldberg 1985 and Masten 1988 for reviews). These activities are consistent with our rationale that parties would strategize in the course of the relationship to increase their ex post bargaining power, and that opportunistic actions sometimes occur in equilibrium as a result of such activities. Under these circumstances, contract terms will be more judiciously crafted ex ante in order to decrease the parties' incentives for strategizing.

Product complexity

Our prediction on the negative effect of complexity on the completeness of price and other contract terms has long been noted in the empirical literature on contracting. In the industrial-machinery sector, Ghosh and John (2005) find that the more difficult for the OEM to specify technical requirements ex ante, the more flexible the price terms and technical-specifications included in their contracts. Recently, Lo et al. (2011) find that, in branded-component contracts, the contracting parties opt for more open price terms and use ex post negotiation rather than fixing price ex ante when the component's technology is more unpredictable.

In sum, evidence in various types of vertical relationships supports the core predictions derived from our model.

5. Conclusion

In this paper, we develop a model investigating the choice of price terms in joint business ventures where the contracting parties bring in pre-existing, non-specific capabilities, and transactions might be uncertain and complex. To generate results on ex post inefficiency, we model a two-stage bargaining process in which the parties' efforts to gather information before production starts can be used to harm their counterparts' valuable capabilities afterwards. We find that once the information is gathered, outright harm, rather than the mere threat of it, may become an equilibrium outcome.

Our main result is that a specific contract prevents wasteful activities (excess information-gathering ex ante and opportunistic behavior ex post) but may cause the parties to overspend in contract design. Specific contracts prevent opportunism because, under the grounds that the renegotiation was extorted under economic duress, the aggrieved party can ask a court to reinstate the original price terms when his counterpart attempts to force a redistributive renegotiation. The prospect of reinstatement discourages information-gathering and, consequently, reduces the parties' ability to harm each other ex post. An important implication of our model is that when the parties bring valuable pre-existing capabilities to the relationship that are vulnerable to post-contractual expropriation, safeguard can be achieved by specifying the price ex ante. Our model therefore extends the TCE rationale for long-term price agreements to settings where the assets brought into production are non-specific.

While we focus on the tradeoff between specific and non-specific contracts, our model of bargaining costs may also be extended to derive a theory of firm boundary in the shadow of the law. Consistent with American legal practice, we assume that, in the presence of *redistributive* contract modifications, courts will reinstate the original contract. Matters become more complicated, however, when the transaction involves high uncertainty like rapidly evolving technologies, since the courts would then be unable to distinguish redistributive renegotiations from efficiency-enhancing ones. One way to insure reinstatement, and hence to fully discourage ex ante and ex post opportunism, is to bring the transaction within a unified firm, where disputes over transfer prices in redistributive renegotiations are resolved by hierarchies, not the court[10].

Finally, while our contracting model is spot, long-term business partners may use relational contracts to prevent ex ante positioning and ex post opportunism. It would be interesting to see how contract design and the parties' behavior change once we allow for relational contracts sustained by repeated interactions. We leave the exploration of these topics for future research.

[10] See Williamson (1991), Hansmann (2010), and Kornhauser and MacLeod (2010).

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