Contract Design when Relationship-Specific Investment Produces Asymmetric Information

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ABSTRACT

Under conventional contract theory, contracts may be efficient by protecting relationship-specific investment from holdup in subsequent (re)negotiation over terms of trade. This paper demonstrates a different problem when specific investment also provides significant private information to the investing party. This is fairly common: for example, a manufacturer invests to learn about its buyer’s idiosyncratic needs or a collaborator invests to learn about a joint venture. We show how such private information can lead to subsequent bargaining failure and suboptimal ex ante relationship-specific investment. We also show that this inefficiency is worse if the parties enter into a binding and renegotiable contract to trade before the investment is made. This may explain why some preliminary agreements are expressly nonbinding. Finally, we demonstrate that parties may reduce inefficiency by agreeing to negotiate in good faith or other such knowledge-based provisions, especially when these promises are backed by expectation rather than reliance damages.

1. INTRODUCTION

Suppose a buyer contacts a manufacturer-seller to buy a good with features that will be tailored to the buyer’s particular needs and circumstances. Although the buyer might provide the product’s specifications to

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fit its purpose, the seller is often in a better position to design the optimal features of the product to meet the buyer’s needs: features that maximize the surplus between the value of the product to the buyer and its cost to the seller. In many such cases, the seller must invest time, effort, and resources to design or innovate the suitable technology or features. Given the buyer’s needs, the seller’s investment is at least partly specific to the buyer and cannot be deployed in sales to other buyers. The parties consequently face the contracting challenges of relationship-specific investment that are central to the literature on incomplete contracts subject to nonverifiability (beginning with Williamson [1975, 1985], Grossman and Hart [1986], and Hart and Moore [1988]). If the seller makes the investment without a contractual commitment from the buyer, it incurs the risk of opportunistic holdup. If the parties agree to a contract price first, the buyer faces the difficulty of ensuring that the seller invests the appropriate amount in optimizing the specifications that affect the value of trade for the buyer. If they try to specify contractually the intended investment, this measure may be difficult to express ex ante and to verify ex post. As explained in Section 2, there is a large vein of scholarship addressing the means by which ex ante investment efficiency can be achieved under alternative informational assumptions of verifiability.

One aspect of this relatively common scenario, however, raises a contracting challenge that, while common in practice, has not been adequately addressed in the literature. The seller’s investment in optimizing technology is termed “cooperative” to the extent that it directly improves the expected value of the product features to the buyer and “selfish” to the extent that it affects the cost of producing the various features (Che and Hausch 1999; Che and Chung 1999; Schweizer 2006). This investment, however, can also provide the seller with private information about the expected value of the product’s various features to the buyer and about the cost of providing these features. The seller may therefore

1. Although we use the product sale as the motivating scenario, there are many other transactions in which the investing party may be endowed with private information: as part of an acquisition due diligence, the acquirer may uncover proprietary information leading it to ask for, or offer, different features or contract terms; in the process of doing research for a joint venture, one party can privately discover new technology that could be of substantial benefit to both parties and can require an adjustment in their initially agreed-on terms, including how they would implement the newly discovered technology to further their joint interest; and an architect, while coming up with a blueprint specific for a client, can privately uncover a new building design that could be of substantial value to the client. Furthermore, while our focus is on transactions between commercially sophisticated entities, the results can also apply to business-to-consumer or even consumer-to-consumer transactions such as house sales.
acquire information about which product features affect the surplus of the proposed trade, and this may necessitate adjusting the terms of the trade ex post. At first blush, the prospect of such informational advantage seems fortuitous in that it could more or less offset the underinvestment caused by holdup concerns. Yet the seller’s private information may also cause the buyer to be wary of the seller’s informational advantage and therefore reluctant to deal on the seller’s ex post proposed terms, even if they would optimize the product’s features. Not only may such reluctance cause ex post inefficiency, but the buyer’s rejection of the seller’s proposal for renegotiation will also dilute the seller’s ex ante incentive to make relationship-specific investment in such innovation.

There are many contexts in which specific investment in design work occurs without compensation or contractual protection, contrary to the predictions of scholars concerned about holdup opportunism. For instance, before being retained under contract, an architect or an advertising agency has to invest in making a pitch with ideas that are (highly) tailored to the needs of their prospective clients. In conventional contract theory, this specific investment seems unwise without a contractual promise from the client to protect it. Some diligence and investment activities that precede joint-venture agreements are similarly unprotected in this way. We are interested also in the investment that parties make in designing the optimal legal provisions for their contract. A party pays lawyers to draft these provisions, and to the extent that this investment is specific to the transaction, it gives rise to holdup opportunity by the counterparty.

In all these scenarios, the investing party must believe that it will recover the sunk cost of its relationship-specific investment in the contract with the counterparty. Under the conventional assumption that the parties can renegotiate the contract ex post without any cost, the investing party will, depending on its relative bargaining power, at least recoup some of its investment. There also is ex post efficiency: the parties are always able to agree to the efficient features ex post. But when the investing party is also endowed with private information as to the features that maximize the surplus of the transaction, the parties face the possibilities of ex post and ex ante inefficiency. A counterparty, aware of the information advantage of the investing party, is worried about being taken advantage of ex post (for example, the seller’s upselling the buyer) and would be more inclined to reject the features subsequently proposed by
the investing party. Not only will this hinder the parties from adopting the efficient features ex post, but such rejection will also deny the investing parties the opportunity to recoup any cost of relationship-specific investment. How can parties address such contracting challenges?

In the first contribution of the paper, we show that the strategy of contracting before investment and relying on renegotiation to achieve the optimal trade can exacerbate these problems. Solutions to problems of underinvestment typically provide that the investing party is protected by a binding agreement to trade. When new information is revealed, the parties can then renegotiate and modify their contract to reach ex post efficiency. We demonstrate that the existence of a binding contract before the making of specific investment exacerbates the ex post and ex ante inefficiencies from the seller's private information because the seller (investing party) has a stake in the initial binding contract that it can readily enforce if renegotiation is unsuccessful. Being able to fall back on an initial binding agreement provides a floor on the investing party's profit and thereby strengthens its temptation to insist on a larger portion of the surplus from the counterparty. This result can explain in part why, in many commercial transactions, parties make specific investments without a binding contract to avoid this incentive. They may enter into memoranda of understanding or other preliminary agreements but expressly stipulate these agreements to be nonbinding, even though they are fully aware that they need to make various deal-specific or relationship-specific investments before they can enter into a fully binding agreement.

The second contribution of the paper improves on the efficiency of eschewing a binding contract before investment: instead of entering into a binding agreement to trade, the parties contract on the knowledge of the investing party as to the quality of offered performance features (rather than the realized value to the counterparty). Whether it concerns a physical feature or a contractual provision, the parties can agree to impose liability on a seller that offers a feature or provision that it knows does not optimize the exchange. An example of a knowledge-based provision is the seller's representation and warranty that the product's features fulfill the buyer's purpose to the best of the seller's knowledge. Another example is the obligation to act in good faith in the negotiation, performance, or modification of a contract, which requires honesty in fact in the conduct
and transaction concerned.\textsuperscript{2} Judicial cases involving such standards of knowledge or honesty typically rely on evidence of dishonesty in internal communications or statements obtained through discovery and oral testimony at trial. If one of these provisions is triggered, the judicial determination will depend on costly and imperfect evidence as to the party's knowledge. Nevertheless, a contribution of this paper is to show that when cost is not prohibitively high, with properly calibrated damages for breach such a knowledge-contingent provision improves ex ante investment incentive and the efficient terms ex post.

A useful case study for this analysis is the preliminary agreement—such as a memorandum of understanding, a term sheet, or a letter of intent—in which the parties include most or all of the significant transactional terms but agree that the terms are not binding until the execution of a final definitive agreement, and the parties will be bound by a legally enforceable obligation to negotiate in good faith.\textsuperscript{3} If, for example, the buyer rejects its seller's offer because it doubts that the seller is being truthful in offering optimal features, the buyer may then sue for breach of the obligation to negotiate in good faith. To the extent that the buyer can offer sufficient evidence of the seller's bad faith, the good-faith obligation may be a tool for mitigating the ex post and ex ante inefficiencies of seller-specific investment in information.

Before we proceed, we offer a few words about outcome-based obligations, such as product warranties, as alternative or complementary solutions to knowledge-based provisions. If the parties cannot contract directly on specific investment, they might condition the seller's contract obligations on the quality of the good and its performance (or the value of its performance) in the hands of the buyer. It is well established in the literature that warranties as to the performance of the product traded to

\textsuperscript{2} Good-faith obligations are important features of contract law: they are mandatory provisions in both the common law and statutes such as the Uniform Commercial Code, and they often appear in the express language of commercial agreements. Good faith governs the parties' actions in the performance of duties or the exercise of discretion under their contracts. It also regulates the modification of their contracts and, if the parties choose, their negotiations, whether or not they result in a contract. Under section 1-201(20) of the Uniform Commercial Code, for example, good faith is defined as "honesty in fact and the observance of reasonable commercial standards of fair dealing."

\textsuperscript{3} We acknowledge that, even in the absence of a legally enforceable obligation, reputational or relational sanctions may discipline the parties' negotiation incentives (Hwang 2018; Choi and Triantis 2020). In this paper, we contemplate a one-shot transaction and set aside these forces.
the buyer can alleviate informational problems when sellers have superior information about the product's features (adverse selection) and the seller can invest resources in improving their quality (moral hazard) (Akerlof 1970; Spence 1977; Grossman 1981; Priest 1981). However, the literature relies on the assumption that the performance of the product (and the loss from its failure to meet the warranty standard) is verifiable. In some cases, however, the court has better evidence of the seller's knowledge as to the quality of the product (for example, from internal communications revealed by discovery from within the seller's organization). In those cases, knowledge-based obligations may outperform warranties, which would be more difficult to verify. There are other reasons for preferring knowledge-based provisions. A warranty is conditioned on the performance of the product, and while influenced by the product's quality, the value of performance is stochastic: even a higher-quality product can yield a low-value outcome with some probability (and vice versa). As a result, the warranty based on performance may underperform because of limitations on the level of damages (such as the rule against supercompensatory damages) and constraints on the seller's ability to pay. Moreover, the warranty obligation imposes risk-bearing cost, even if the product is of high quality, on a risk-averse seller. In contrast, if sufficiently verifiable, the knowledge-based obligation can be superior because it refers to the quality of the product at the time it is sold rather than on the value of the performance, which is influenced also by the buyer's use of the product and exogenous risks.

The paper is organized as follows. In Section 2, we briefly review the

4. Warranties may be either express or implied by law as default terms. Article 2 of the Uniform Commercial Code, which governs contracts for the sale of goods, contains default warranty terms. In addition to the warranties of description and of merchantability, section 2-315 provides an implied warranty of fitness under which the seller warrants that the delivered goods will be fit for the buyer's purpose when the seller has reason to know of the buyer's particular purpose and the buyer relies on the seller's skill or judgment to select or furnish suitable goods.

5. In addition, the parties may agree to limit the warranty to address moral hazard in enforcement, whereby the buyer might otherwise exploit the cost and error in verification by suing even when there is no breach in truth.

6. The existing literature identifies other reasons why warranties may be insufficient and, correspondingly, why knowledge-based obligations serve as valuable alternatives or complements (Priest 1981; Lutz and Padmanabhan 1998). One is buyer heterogeneity, under which buyers have different probabilities of suffering harm, and the other is buyer moral hazard, under which the buyer can take precaution to reduce the chances of an accident.
relevant contract theory scholarship examining the problems of ex ante and ex post contract efficiency and the law-and-economics treatment of preliminary agreements. We highlight the fact that most of the literature assumes that the contracting parties can costlessly renegotiate the contract (usually with an express or implicit assumption that they are symmetrically informed ex post) and focuses primarily on the question of how to provide efficient ex ante investment incentive. Our paper differs by focusing on ex post renegotiation challenges that are brought by asymmetric information. Section 3 presents the basics of the model. In Section 4, we compare the inefficiency resulting from the private information gained by the investing party under two scenarios: the specific investment occurs before the parties enter into a contract and the specific investment occurs after an initial contract but before its modification. The analysis demonstrates how the first regime will generally be better than the second regime.

Section 5 introduces knowledge-based contract provisions and shows how such provisions, when verification cost is not prohibitive, can better allow the parties to achieve both ex ante and ex post efficiency. We examine three ways in which knowledge-based obligations can be used. In the first, parties enter into a binding agreement to trade only after the seller has invested, but the agreement allows the buyer to receive a remedy based on the breach of a knowledge-based obligation (for example, the seller's misrepresentation). In the second, parties execute a binding agreement to trade before the seller invests, and the agreement obligates the parties to renegotiate (modify) the agreement in good faith when the investment reveals relevant new information. In the third, the parties agree to negotiate in good faith before the seller's investment without entering into any binding agreement to trade. Section 5 also shows that when the court is sufficiently accurate, expectation damages for breach of knowledge or good-faith obligations are more likely than reliance measures to allow the parties to achieve the first best. Section 6 concludes. Appendix A contains the proofs, and Appendix B offers an extension that examines the setting in which the uninformed buyer chooses whether to bring suit against the seller without knowing if the seller made a bad-faith renegotiation (modification) offer.
2. RELEVANT SCHOLARSHIP

Over the past 30 years, numerous contract law and theory scholars have examined the challenges of encouraging contracting parties to make beneficial relationship-specific investments in the presence of nonverifiability. Economics scholarship focuses mostly on the issues of underinvestment that is due to anticipated holdup and addresses the mechanisms that can be used to encourage the efficient level of investment. If the parties can contract directly to require specific investment or to protect that investment with appropriately measured reliance damages, then they can easily resolve the holdup problem. The literature focuses on conditions under which the relevant transactional variables (such as the value to the buyer, the cost to the seller, and the parties’ relationship-specific investment) are not verifiable. The parties can achieve ex post trade efficiency if they are symmetrically informed of the relevant parameters (and their realizations) and can costlessly renegotiate any initial agreement (Grossman and Hart 1986; Hart and Moore 1988; Hart 1995; Edlin and Reichelstein 1996; Che and Hausch 1999). But without protection of specific investment, the noninvesting party can hold up the investing party in renegotiations, which leads to underinvestment. In a sense, the contracting parties are extremely good (or perhaps too good for their own good) at renegotiating the initial agreement, while the courts lack the information to provide the necessary enforcement against opportunistic behavior (namely, holdup).

Scholars have examined this issue in different manifestations and have suggested various mechanisms to overcome (or at least mitigate) the nonverifiability and holdup problem. The literature can be categorized in many ways, including whether the investment is selfish, cooperative, or a combination of the two; whether the court can verify certain information, such as the amount invested, the cost of performance, and the value of performance to the counterparty or whether delivery has occurred; and whether the parties are symmetrically informed (observability) about these parameters. The mechanisms suggested in contracts scholarship depend on the assumptions about the nature of the investment and the in-

7. Schmitz (2006, 2017), by contrast, examines the problems of asymmetric information and assumes that the investing party has private information regarding his reservation value. His articles examine the optimal allocation of asset ownership to the investing or noninvesting party. By comparison, our analysis focuses on the asymmetric information regarding the value of the investment and the choice among various contractual arrangements in mitigating the problems of asymmetric information.
formational conditions. As Stremitzer (2012) notes, the scholarship on the economics of standard contract law remedies (such as expectation and reliance damages) often implies rather than expresses assumptions. In most cases, these scholars argue that specific investment should be properly protected using reliance (and not expectation or other) damages, which assumes that specific investments are verifiable (Farnsworth 1987; Katz 1996; Craswell 1996; Johnston 1999; Bebchuk and Ben-Shahar 2001; Schwartz and Scott 2007).

This paper examines relationship-specific investments and contributes to the literature by relaxing the usual assumption that the parties are symmetrically informed ex post. We assume that after the parties have made relationship-specific investment and all the relevant parameters have been realized, the investing party is better informed of the relevant parameters of the transaction than the other party, and this leads to a possible ex post renegotiation failure. As contract theory recognizes, such renegotiation failure makes it difficult to achieve ex post trade efficiency, but we show that it also upends the ex ante investment incentives. Our contribution is to demonstrate that this inefficiency is exacerbated if the parties

8. Nöldeke and Schmidt (1995), for instance, show that a simple option contract, which gives the seller an option to deliver the good and stipulates two prices (on delivery or nondelivery), can achieve both ex post and ex ante efficiency when relationship-specific investments are purely selfish. In a similar vein, Edlin (1996) shows that a “Cadillac” contract (setting the required quality at the highest possible level), with an up-front payment, can achieve the first-best level of relationship-specific investment when the court can form an unbiased estimate of damages. By contrast, Che and Hausch (1999) show that when one party’s investment is more cooperative than selfish, no contract may be better than any contract if the investment and the realized value are not verifiable and the parties are unable to commit not to renegotiate. Brooks and Stremitzer (2011) and Stremitzer (2012) show that efficient cooperative investments may be induced, even when the investment and the value thereof are not verifiable, by a contract that specifies a required quality for the performance (assuming the quality of performance is continuous) and allows the counterparty the choice at breach between specific performance and restitution. This work assumes that the court can verify whether the quality of the performance meets (or not) a contractual threshold. Göller and Stremitzer (2014) extend the result to hybrid investments. In these articles, ex post renegotiation (or being unable to commit not to renegotiate ex post) functions as an important obstacle against providing efficient ex ante investment incentive. In fact, under certain parameter conditions, especially when there is a one-to-one relationship between the investment and the contractual surplus, the parties may be able to avoid ex post renegotiation altogether (Edlin 1996; Che and Hausch 1999; Brooks and Stremitzer 2011; Stremitzer 2012). In our analysis, by contrast, ex post renegotiation is necessary to incorporate new information learned by the investing party (the seller in our example).
try to contract before making the specific investment. We argue that this provides an explanation for why commercially sophisticated parties often enter into an expressly nonbinding agreement (such as a memorandum of understanding) before they embark on deal-specific or relationship-specific investments.

The common assumption that parties can costlessly renegotiate ex post places a scholarly focus on the efficiency of relationship-specific investment. As a result, it has left important aspects of contract law unexplained, including the use of state-of-mind standards, such as good faith. In Section 5, we explore provisions that condition on the investing party’s knowledge of the quality of her performance. We depart from the conventional binary treatment of verifiability (that a parameter is either verifiable or not) and allow the court to verify certain variables at a cost that includes both the court’s error (both type I and type II) and the cost of adjudication. While we could do this with respect to any parameter, we are particularly interested in the ability of a court to observe evidence of the parties’ knowledge and state of mind, particularly in the negotiation of contract terms. We are motivated to do so by the observation that such provisions are common in both express terms in commercial contracts and the default provisions in background law, such as the obligation of good faith. In particular, it is well known (see, for example, Hwang 2018) that negotiating parties often do not enter into a binding agreement while designing the terms of their exchange but choose instead to agree to negotiate in good faith. Judges enforce such agreements, whether express or implied and sometimes in the context of what is known as a type II preliminary agreement, by measuring and awarding expectation damages for breach of good faith (Teachers Ins. and Annuity Assoc. of Am. v. Tribune Co., 670 F. Supp. 491 [S.D.N.Y. 1987]; Choi and Triantis 2020).

In addressing the asymmetric information between the parties, our paper is related to Craswell (1988) and Shavell (1994), in that a contracting party (either the buyer or the seller) can discover information, at cost, about the terms of the transaction (for example, the buyer’s valuation of the good to be traded) before the parties enter into a contract. Craswell

9. A behavioral strand of contracts scholarship similarly suggests that renegotiation may lead to inefficiencies that are avoided by negotiating from a nonbinding contract rather than a binding contract, even if the parties are symmetrically informed. For example, Herweg and Schmidt (2015) show that loss aversion may prevent renegotiated outcomes from deviating sufficiently from the initial contract to reach the efficient trade, and Bartling and Schmidt (2015) suggest that buyers may reject efficient contracts if they have a high markup from the initial contract.
(1988) examines the effect of damage measures on incentives to invest in such information, while Shavell (1994) compares regimes of mandatory and voluntary disclosure. Our analysis is different from both articles because we allow the parties to contract (either a binding agreement to trade or simply an agreement to negotiate in good faith) before one of the parties makes an investment that leads to information acquisition. Unlike in the regime in which disclosure can be mandated by law, our analysis relies more on the parties' ability to seek a private ordering solution. In addition, we (partially) relax the verification issue. Instead of assuming that the parties (or the law) can perfectly and costlessly enforce the disclosure regime (especially when the law mandates disclosure), we incorporate costly verification (an error-prone court and litigation cost) in the context of examining the duty to negotiate in good faith.

3. THE MODEL'S SETUP

The model examines the effect of contract design on ex post and ex ante efficiency when one party can make a cooperative, relationship-specific investment that increases the expected contracting surplus and gives the investing party private information. Such investment might be tailoring a marketing campaign, architectural designs, features of a product or contract terms to the particular needs of the buyer. We build a simple game-theoretic model to demonstrate the ex post and ex ante inefficiency that results from the seller's information advantage in a single-shot contracting negotiation. We then demonstrate how the inefficiency is exacerbated when the parties contract before the seller's investment with a view to modifying it afterward, which explains why some parties might avoid contracting before information-revealing specific investment occurs.

3.1. The Players

Suppose there are one buyer and one seller, \( i \in \{B, S\} \), who are negotiating over a transaction. The transaction could be an architectural design, advertising campaign, joint venture, or merger and acquisition. For convenience, we adopt the example of a sales transaction in which the buyer (she) agrees to purchase a good from the seller (he). Their contract has two categories of terms: price and quality (nonprice). Let \( k = (p, q) \) represent an agreement. The quality term \( q \) determines the size of the surplus from the trade, while the price term \( p \) determines how that surplus will be
split between the parties. For ease of illustration, we let various attributes of the product be represented by the quality term $q$. Also, for the sake of simplicity, we assume that both parties’ reservation values are normalized to 0 and are common knowledge: $r_B = r_S = 0$.

### 3.2. The Product’s Attributes

We assume that, in the absence of any investment, the parties will enter into an agreement $k_0 = (p_0, q_0)$, which we label the default agreement. Under the default agreement, the buyer expects to realize the value $v_0 > 0$, the seller expects to incur the cost $c_0 \geq 0$ in producing and delivering $q_0$, and the expected contract surplus is strictly positive: $v_0 - c_0 > 0$. Consistent with the concept of default in contract law scholarship, the default quality features reflect standard attributes in the industry. The default warranty of merchantability under Uniform Commercial Code section 2-314, for example, requires that a merchant deliver goods that would pass without objection in the trade under the contract’s description and are fit for the ordinary purposes for which such goods are used. However, the default set of attributes may not be optimal for a given buyer, so there may be a positive return to investing in identifying the optimal attributes.

Suppose there is a very large (potentially infinite) set of alternative attributes: $q_i \in \{q_1, q_2, \ldots, q_T\}$, where $T \gg 0$. For simplicity, we assume that all but two ($T - 2$) of the alternative attributes generate the same surplus as the default: $c_i = c_0$ and $v_i = v_0$, so $v_i - c_i = v_0 - c_0$. This setup is similar to that in Aghion and Tirole (1997).\(^{11}\)

At the same time, one of the $T$ possible attributes will generate a larger surplus: we assume that there always exists a $j^* \in \{1, 2, \ldots, T\}$ such that $v^* - c^* > v_0 - c_0$. The larger surplus can come from higher valuation for the buyer ($v^* > v_0$), lower production cost for the seller ($c^* < c_0$), or both. There also exists a $j^{**} \in \{1, 2, \ldots, T\}$ such that $j^{**} \neq j^*$, $v^{**} - c^{**} \ll v_0 - c_0$, $v^{**} < v_0$, and $c^{**} > c_0$. The attribute $j^{**}$ represents a terrible (the worst) option for the parties. We assume that although the parties know the values of $v^*$, $c^*$, $v^{**}$, and $c^{**}$, they do not know which features (identities of $j^*$ and $j^{**}$) will yield them. Finally, the buyer’s values

\(^{10}\) Schmitz (2006) provides an analysis of what happens when the ex post reservation value is private information.

\(^{11}\) Aghion and Tirole (1997) focus on the principal-agent relationship and (formal or informal) delegation of authority but do not allow for either renegotiation or costly verification (of realized state or renegotiation behavior), as we do in this paper. The assumption of $T \gg 0$ is to ensure that the number of possible states is sufficiently large and is very difficult to contract over ex ante.
and the seller's costs are such that if they were to choose one of the $T$ attributes at random, the buyer expects to realize $E(v) = v_1$, and the seller expects to incur $E(c) = c_1$, where $v_0 - c_0 > v_1 - c_1$. Hence, if they do not know the identities of $j^*$ and $j^{**}$, staying with the default option remains better than a random choice among the $T$ alternatives.

Collecting the different value and cost parameters, we make the following important regularity assumption:

$$v^* - c^* > v^* - c_1 > v_0 - c_0.$$ 

The assumption makes the analysis more interesting and more tractable. The first inequality $(v^* - c^* > v^* - c_1)$ ensures that the parties will have an incentive to find the optimal set of attributes, since the optimal set generates the largest surplus. The second inequality $(v^* - c_1 > v_0 - c_0)$ creates a condition such that, even when the default terms $(v_0, c_0)$ are optimal, the seller (who may be better informed after the investment, as described below) will have an incentive to attempt to renegotiate a new set of attributes solely to extract more rent from the buyer: the second inequality allows for possible opportunism.

3.3. The Seller's Ex Ante Investment

Although the best and the worst options are initially unknown to the parties, the seller can make an investment to learn about the value and cost of the alternative attributes (that is, identify $j^*$ and $j^{**}$). We assume that the buyer does not have this opportunity and therefore would have inferior information ex post. Suppose the seller can make an unobservable investment of $l \geq 0$ at a cost of $u(l)$ and discovers the best and the worst options with a probability of $a(l) \in (0, 1)$. We assume that $\alpha'(l) > 0$, $\alpha''(l) < 0$, $\psi'(l) > 0$, $\psi(0) = 0$, and $\psi''(l) > 0$ $\forall l$. If the optimal contract has both lower cost and higher value ($c^* < c_0$ and $v^* > v_0$), the investment has both selfish and cooperative components (consistent with the definitions in Che and Hausch [1999], Che and Chung [1999], Schweizer [2006], and Göller and Stremitzer [2014]). In sum, with a probability of $a(l) \in (0, 1)$, the seller discovers that an agreement containing $q^*$ is optimal; with a probability of $1 - a(l)$, the seller discovers nothing, and given that deviating from the default by choosing some alternative feature at random will lower the surplus in expectation, the standard feature $(q_0)$

12. If $c^* < c_0$ and $v^* \leq v_0$, the investment is selfish in the sense that the investment lowers the seller's cost but may have little effect on the buyer's value. If $c^* \geq c_0$ and $v^* > v_0$, on the other hand, the investment is cooperative. If $c^* < c_0$ and $v^* > v_0$, the seller's investment is of a hybrid nature.
remains optimal (in expectation) for the buyer and the seller (similar to the assumption in Aghion and Tirole [1997]).13

The discovered knowledge is private to the seller. This implies that, depending on the information learned by the seller, we can divide sellers into two types: the high-type seller ($\theta = H$), who knows that the optimal product feature $j^*$ is given by $q^*$ and with whom the buyer should modify the contract to $k^* = (p^*, q^*)$, and the low-type seller ($\theta = L$), who does not have information that the optimal quality is any level other than $q_0$ and with whom the buyer should trade under the default terms $k_0 = (p_0, q_0)$. The buyer does not observe which type of seller she is facing but knows that the probability is given by $\alpha(l) \in (0, 1)$. As we will see shortly, the fact that only the seller knows the realized state of the world imposes a significant barrier against efficient renegotiation.14

3.4. Sequence of the Game

There are five periods with no time discount: $t \in \{0, 1, 2, 3, 4\}$. We assume that throughout the game the seller can make a take-it-or-leave-it offer to the buyer, who either accepts or rejects it. This allows the seller to make a costly signal of his information to the buyer because of the possibility that the buyer may reject his offer.15 At $t = 0$, the parties have

13. To keep the analysis simple, we assume the binary risk that either the seller learns of the optimal features or learns nothing (in which case it is optimal to trade on the default features). If the seller learns the optimal feature, he offers it to the buyer, and we exclude the possibility that a knowledgeable seller would trick the buyer into a less-than-optimal feature.

14. Although, for ease of exposition, we assume throughout that the seller’s choice over any attribute $j$ determines both the cost of production and, more importantly, the value for the buyer, the value $v$ can also be assumed to be in expectation, and the realized value of the good might be higher or lower. This allows for the possibility that even choosing the optimal features could produce a low valuation for the buyer (and choosing suboptimal features could nevertheless result in a high valuation). In terms of implementing a more efficient renegotiation regime, however, what is important is that the seller’s optimal choice is more likely to produce a higher value for the buyer (in the first-order stochastic dominance sense). This will allow the high-type seller to separate himself from the low-type seller in the renegotiation game. Moreover, as we indicate in Sections 1 and 5.5, the stochasticity in the realized value for the buyer also makes a warranty a suboptimal solution to the problem of information asymmetry regarding quality.

15. As in the seminal work Spence (1973), in a separating equilibrium, the high-type seller will incur this cost when the buyer rejects the offer with some positive probability (while the low-type seller does not). Making the seller make the take-it-or-leave-it renegotiation offer also allows the parties to provide the maximal investment incentive to the seller. If the buyer were to capture some of the surplus from information acquisition and renegotiation, the seller’s investment incentive will decrease. As we will show, even with
an opportunity to enter into a binding agreement (a contract) to trade under the default terms $k_0 = (p_0, q_0)$. More precisely, the parties have three choices: a contract to trade, no contract, and no contract other than a promise to negotiate in good faith. At $t = 1$, the seller can invest $l_t$ to find the optimal feature with a probability of $\alpha(l_t) \in (0, 1)$ at a cost of $\psi(l_t)$. As mentioned above, the information is private to the seller, and depending on the realization the buyer faces one of two types of seller: the high-type seller ($\theta = H$), with whom she should trade under $k^* = (p^*, q^*)$, or the low-type seller ($\theta = L$), with whom she should trade using the default terms $k_0 = (p_0, q_0)$.

At $t = 2$, the parties negotiate the terms of their exchange (or renegotiate if they entered into a contract at $t = 0$). The parties’ negotiation will determine whether they ultimately agree to the default terms, agree to alternative features proposed by the seller, or do not transact. If they enter into a contract at $t = 2$, in addition to the features and the price of the product $(p_R, q_R)$, they can include a knowledge-based provision, under which the seller represents (to the best of his knowledge) that the product comes with the optimal features. At $t = 3$, the parties trade if there is a contract, and they realize the value and the cost of the trade. Finally, at $t = 4$, the buyer may be able to bring a breach-of-contract suit against the seller, including for breach of a knowledge-based provision.

Our paper presents a justification for the use of provisions other than warranties and indemnifications to address the ex post and ex ante inefficiencies we identify. We assume that the parameters of the trade at the time of performance $(v_t$ and $c)$ are not verifiable and not contractible. However, as described below, we assume that the seller’s knowledge, the maximal incentive, because of the challenges of achieving successful ex post renegotiation, the seller’s investment incentive will be suboptimal in many settings. How ex post transactional inefficiency leads to ex ante investment inefficiency is similar to the problems of successor liability (Choi 2007).

16. Unlike Hart and Moore (2008), in our setting the terms of the initial agreement do not act as reference points in affecting the parties’ renegotiation payoffs or sense of entitlement. The parties are fully able to renegotiate the terms of the initial agreement. Instead, they face renegotiation challenges in the form of private information. Consistent with Hart and Moore (1988), we exclude the theoretical possibility that the parties can play a more complex message game (for instance, the seller gets to communicate more than just the quality and the price).

17. Given that the seller is the party who receives private information before renegotiation, we can also assume that his choice over product attributes, including his cost of producing the good, is also unobservable by the buyer or at least not until she has received the good and observed the realized valuation.
Figure 1. Sequence of the game

honesty, or good faith can potentially be verified at cost and with some risk of error, so that the parties may condition sanctions on it. In the model, the seller knows his type and can promise not to pretend or misrepresent to be the high type. We recognize, in particular, that the process of discovery and evidence production in litigation allows the court to observe evidence of (or signal) the parties' honesty and knowledge during the negotiation process at \( t = 2 \). We will be more precise about the litigation process below. Figure 1 shows the sequence of the game.

4. EX ANTE AND EX POST EFFICIENCY WITHOUT KNOWLEDGE-BASED OBLIGATIONS

In this section, we assume that knowledge-based obligations (such as an obligation to negotiate in good faith or not to misrepresent) are not available, and we provide three results. After presenting the first-best benchmark, we show that parties negotiating an agreement after the seller’s investment would be unable to achieve either ex post or ex ante efficiency. We then show that if the parties were to enter into a binding contract to trade before the seller’s investment, with the hopes of renegotiating it afterward, these inefficiencies would be worse.

4.1. The First-Best Benchmark

If the social planner were to choose the type of trade and the amount of investment, it would choose \( q^* \) whenever the optimal additional feature has been identified and \( q_0 \) otherwise. In terms of the seller’s investment, the planner will choose \( i_t \) to maximize

\[
\alpha(i_t)(v^* - c^*) + (1 - \alpha(i_t))(v_0 - c_0) - \psi(i_t).
\]
Maximization yields the following first-order condition:
\[ \alpha'(l_s)[(v^* - c^*) - (v_0 - c_0)] = \psi'(l_s). \]

Given the assumptions, we get a unique \( l_s \) from the condition. The amount of investment by the seller should maximize the expected return from producing the additional surplus (given by \((v^* - c^*) - (v_0 - c_0)\)) and equate that to the marginal cost of investment (given by \( \psi'(l_s) \)). Let \( l_s^* > 0 \) represent the first-best level of investment.

4.2. The Postinvestment Contract

If the seller invests before the parties contract, he will attempt to exploit his resulting informational advantage to extract more rent from the uninformed buyer. When the informed seller purports to offer the optimal product features to the buyer, the uninformed buyer is skeptical and less inclined to enter into the transaction. This will undermine both ex post and ex ante efficiency. Proposition 1 shows that this risk of seller opportunism may prevent the parties from achieving the first best.

Proposition 1. Suppose there is no agreement between the parties at \( t = 0 \), but they can enter into a contract after the seller’s investment at \( t = 2 \). In a separating equilibrium, the low-type seller always trades with the buyer under optimal terms \( (q_0) \), but the high-type seller trades with the buyer with optimal terms \( (q^*) \) with a probability less than 1. The seller makes a positive but suboptimal investment \( (0 < l_s < l_s^*) \).

If the buyer does not know the seller’s type, she will be suspicious that he may be pretending to know the optimal quality while in fact he is simply picking a quality at random. The reason the parties are nevertheless able to successfully enter into a deal—at least with some positive probability—and implement the optimal terms stems from two sources. First, when there is no contract, the low-type seller realizes no profit if the parties subsequently fail to contract. For the low-type seller, mimicking the high type is therefore a very risky proposition. Second, the high-type seller earns a strictly larger profit by offering the optimal terms \( (q^*) \). This implies that the high-type seller has a stronger incentive to offer the optimal terms than the low-type seller. With these two incentives in place, the parties are able to at least partially separate on the basis of seller type and implement the optimal terms.
4.3. Preinvestment Contract with Postinvestment Modification

Suppose that at \( t = 0 \) the buyer and the seller contract on default terms: \( k_0 = (p_0, q_0) \). Skipping over the investment period for the moment, let us examine the parties’ incentive over renegotiation. At \( t = 2 \), the parties will decide whether to agree to a modification of the default terms. If they do not, they remain obligated to trade under the initial default terms. As noted earlier, the seller will be either the high-type seller, who has discovered that the optimal terms for the contract is \( q^* \), or the low-type seller, who knows that the optimal contract should contain the default terms \( q_0 \). The buyer knows only that she is facing the high-type seller with a probability of \( \alpha(l_s) \in (0, 1) \).

The fact that the low-type seller is guaranteed to receive the return of \( v_0 - c_0 \) if the renegotiation fails implies that he has basically nothing to lose by mimicking the high-type seller. Given that the low-type seller does not know which attribute is optimal, he will randomly choose an attribute among \( q_i \in \{q_1, q_2, \ldots, q_T \} \) and opportunistically claim that this will produce a larger value. The buyer, rationally expecting this, will reject all renegotiation offers, and the parties will be stuck with the default terms.\(^{18}\) We state the result first and then provide a simple analysis.

Proposition 2. Suppose the parties enter into a preinvestment binding agreement of \( k_0 = (p_0, q_0) \) at \( t = 0 \) that they can modify after the seller has the opportunity to invest (at \( t = 2 \)). In equilibrium, the seller makes no investment \( (l_s = 0) \), and the parties always trade under the default terms \( (q_0) \).

Ex post and ex ante inefficiencies are worse when the parties renegotiate a contract after investment that produces private information for the investing party than when they wait to reach an agreement after such investment. In the latter case, the parties face a positive probability of implementing the optimal terms. The intuition is that with a binding trade contract at \( t = 0 \), the low-type seller has nothing to lose by mimicking the high-type seller: if the buyer rejects, the seller still enjoys the profit from the initial deal.\(^{19}\) Where they do not have a binding contract, by contrast, the low-type seller is not guaranteed of the profit from the initial deal if

18. We assume for the moment that the parties do not have an obligation to renegotiate (or modify the contract) in good faith, and we analyze the impact of such obligations in Section 5.3.

19. In theory, even with a binding initial agreement, the seller can make a renegotiation offer with a condition that if the buyer rejects the renegotiation offer, the initial agreement also disappears. This will eliminate the default option to fall back on for the informed seller. Such a conditional contract, however, is tantamount to no contract at \( t = 0 \).
the renegotiation fails. For the low-type seller (who is not aware of the optimal attribute), mimicking the high-type seller becomes a risky venture, since the buyer's rejection will lead to no profit. In addition, when negotiating the contract after the investment, the high-type seller earns a strictly larger profit by offering the optimal features. This implies that the high-type seller has a stronger incentive than the low-type seller to offer the optimal terms. With these two incentives in place, the parties are able to at least partially separate on the basis of seller type and implement the optimal terms.

This result may offer an explanation for why parties often defer entering into a binding agreement before one party makes a specific investment, despite the holdup danger that motivates much of contract theory.\textsuperscript{20} Commercial parties may memorialize their tentative terms in a preliminary agreement but often expressly stipulate that the preliminary agreement is not binding (at least with respect to the deal's terms), even if the agreement contains most, if not all, of the essential terms of the deal. For instance, in a letter of intent for a corporate acquisition transaction, it is customary for the parties to expressly stipulate that the terms of the transaction, such as the consideration offered and deal structure, are expressly nonbinding while agreeing to be bound by other (secondary) promises, such as that of exclusivity, nondisclosure, and standstill.\textsuperscript{21} Similarly, when an architect presents a design to a prospective client that is highly tailored to the client's needs, the client is under no obligation to accept the design or even contract with the architect. Proposition 2 provides an explanation for such behavior by demonstrating that parties are better off postponing their contract when they anticipate a possible renegotiation failure due to the problems of asymmetric information. This result is in contrast to the well-known result in incomplete-contract theory:

\textsuperscript{20} In fact, we set aside the holdup problem here by assuming that the investing seller has all the bargaining power. If the buyer had some or all of the bargaining power, the holdup risk would need to be weighed against the efficiency concerns we describe.

\textsuperscript{21} For instance, the American Bar Association (2010, sec. 12) model letter of intent states that "the provisions . . . of this letter [the deal terms] are intended only as an expression of interest on behalf of Buyer, are not intended to be legally binding on any party or Acquired Company [the target], and are expressly subject to the negotiation and execution of an appropriate Definitive Agreement. In addition, nothing in this letter should be construed as an offer or commitment on the part of Buyer to submit a definitive proposal." While such express disclaimers are fairly common, in other transactions the parties expressly agree to negotiate the final terms in good faith. In the model term sheet from the National Venture Capital Association (2019, p. 14), for instance, the no-shop/confidentiality paragraph stipulates that "the Company agrees to work in good faith expeditiously towards a closing."
that allowing parties more flexibility in renegotiation (or modification) can undermine the initial investment incentive through possible holdup.

5. KNOWLEDGE-BASED PROVISIONS IN CONTRACTS

To address the ex post and ex ante inefficiencies, the parties' contract might condition economic incentives on output or input. All these tools are common: sellers make warranties of quality, promise to indemnify, or promise to invest specified amounts or to apply their best efforts or reasonable care to meeting the buyer's requirements or needs. In Section 1, we identified shortcomings recognized in the literature to the effectiveness of warranties of outcomes, which leaves room for improvement by using other mechanisms. There is another category of provisions that conditions on the seller's information or knowledge at the time of contracting. These knowledge-based provisions can be in the form of sellers' representations, particularly promises that a statement of fact (such as the seller's type in our model) is true to the best of his knowledge at the time it is made. The promise of good faith is a more general commitment that the seller will be truthful. As a mandatory legal rule, the duty of good faith applies to the performance and enforcement of every contract. The parties can expand on this duty in their agreement. One instance is when they agree to negotiate the terms of a transaction in good faith, which is generally defined as honesty in fact and the observance of industry standards of fair dealing. Given the emphasis on honesty and the motivation of a party in its performance of a contract, good faith relates to the party's knowledge and intent.

Contract theorists focus much of their analysis on the obstacles of verification of contract conditions. In most cases, they identify provisions as being either verifiable or nonverifiable. In reality, however, verification is not a binary variable but one that involves varying cost and risk of judicial error. In previous work, we explain how the cost and error need not prevent the use of vague contract terms but can be managed in the design of contract remedies (Choi and Triantis 2008, 2010). To illustrate, we use common provisions that condition on a party's best efforts or the occurrence of a material change. The analysis also applies to the knowledge-based provisions. A party's knowledge is not easily verified, but litigation does produce documentary and testimonial evidence as to what the seller knew and whether he was honest. As with other features, this entails litigation cost and the risk of error, but these are often not preclusive and can be managed. In this section, we explore two types of
knowledge-based provisions. One type is included in the contract at $t = 2$ (ex post knowledge-based provision), while the other type is included in the contract at $t = 0$ and anticipates the investment and future negotiation of the final contract. In the second scenario, the obligation can be part of a contract at $t = 0$ (ex ante knowledge-based provision with a contract to trade) or on its own (ex ante knowledge-based provision without a contract to trade).

5.1. Judicial Enforcement of Knowledge-Based Provisions

The parties' agreement might include a representation that, to the best of the seller's knowledge, he is offering optimal quality features given the needs of the buyer and his own cost structure. In that setting, after the buyer has received delivery from the seller and has observed the realized value, she can bring a suit against the seller. There are different doctrinal ways of classifying such a lawsuit. One possibility is for the buyer to allege that the seller engaged in misrepresentation. When the low-type seller mimics the high-type seller, he knowingly misrepresents the value of the product to the buyer. Another possibility is for the buyer to allege breach of good faith and fair dealing in the seller's performance of its contract.\(^{22}\)

Determining whether the seller breached his misrepresentation or failed to act in good faith requires some contextual determination by the court, and this involves costly verification. We can think of two possible components in the cost: court error (type I and type II) and the cost of litigation (dispute resolution). Suppose the court examines evidence of the negotiation process, and particularly the knowledge of the seller as to his type. For the purposes of the model, good faith is satisfied when either a low-type seller offers the default quality or a high-type seller offers the optimal quality $q^*$.\(^{23}\) Suppose the court renders the correct judgment with a prob-

22. As noted earlier, good-faith obligations are important features of contract and commercial law. In our model, when the low-type seller offers the high-price renegotiation offer, he is being both dishonest in fact (by not disclosing that the default contract is still optimal for the buyer) and dealing unfairly with the buyer (such as by making the high-price renegotiation offer).

23. We make the assumption that the realized parameters ($v$ and $c$) remain nonverifiable until later. Hence, the inquiry about whether the seller acted in good faith is looking at the bargaining process rather than examining whether the contract has been breached. For instance, the requisite inquiry can be whether the seller knew or had information that the modified offer was value decreasing (or not suitable) for the buyer. The possibility of allowing the court to delve into the negotiation process to determine whether one party acted in good faith is similar to the approach taken in Daughety and Reinganum (1997), which analyzes the problems of misrepresentation by a manufacturer in a product liability setting.
ability of \( \lambda \in (\frac{1}{2}, 1] \); if the low-type seller makes an offer of \((v^*, \tilde{q})\) and the buyer brings suit, the court determines that the seller acted in bad faith with a probability of \( \lambda \) (or exonerates him with a probability of \( 1 - \lambda \)). Similarly, if the buyer (opportunistically) brings suit against the high-type seller, the court determines that the seller acted in good faith with a probability of \( \lambda \) and finds him liable with a probability of \( 1 - \lambda \). Given that the probability the court renders the correct judgment is \( \lambda \in (\frac{1}{2}, 1] \), its determination is, on average, informative of the true behavior of the seller.

Finally, let us assume that the litigation costs the buyer and the seller \( \phi_B = \phi_S = \phi > 0 \). Combining the litigation cost and the judgment probability, we can imagine that by expending the litigation cost \( \phi \), the parties can uncover evidence (or signal) that allows the court to make a determination with a probability of \( \lambda \).

Given that the court’s determination is (at least partially) informative, if the damages \( (d > 0) \) are set at the right level, the parties can induce only a legitimate suit to be filed. For instance, the buyer who is duped by the low-type seller will bring suit when \( \lambda d - \phi \geq 0 \). The buyer who fails to execute a contract with the high-type seller, on the other hand, will (opportunistically) bring suit if \( (1 - \lambda)d - \phi \geq 0 \). To induce the buyer to

24. By assumption, \( 1 - \lambda \) measures the sizes of type I and type II errors. As \( \lambda \to 1 \), both error types disappear, and as \( \lambda \to \frac{1}{2} \), both error types increase. We can easily relax this assumption by letting the type I error be denoted \( 1 - \lambda_l \) and the type II error be denoted \( 1 - \lambda_r \). In that case, to achieve the desired screening result, the parties will have to set the damages such that \( \phi/(1 - \lambda_l) \leq d < \phi/(1 - \lambda_r) \). The rest of the analysis follows.

25. The scenario we are interested in is that in some cases the evidence of the seller’s knowledge may be more probative than that going directly to the value of the product.

26. When the buyer’s and the seller’s litigation costs are different \( (\phi_B \neq \phi_S) \), the rest of the analysis is the same, but the litigation costs play different roles. The buyer’s (plaintiff’s) litigation cost determines the desired size of damages \( \phi_B/\lambda \leq d < \phi_B/(1 - \lambda) \), while the seller’s (defendant’s) litigation cost determines the size of total deterrence \( \lambda d + \phi_S \).

27. Although in theory the parties may be able to contract on this ex post evidence to better provide investment and renegotiation incentives ex ante, it would be reasonable to assume that, because there are so many (possibly infinitely many) different types of evidence that can be uncovered ex post, it may be prohibitively costly to contract on such evidence types at \( t = 0 \). Also, if the parties expect the court’s verification mechanism to be extremely poor (for example, \( \lambda \to \frac{1}{2} \), \( \phi \to 0 \), or both), per propositions 1 and 2 the parties will simply fall back to a fully nonbinding preliminary agreement rather than impose the duty to negotiate in good faith.

28. To break ties, when the buyer is strictly indifferent between bringing and not bringing suit (the expressions are replaced by an equals sign), we assume that the buyer brings suit.
bring suit only when she has been serviced by the low-type seller, therefore, it must be the case that

\[ \frac{\phi}{\lambda} \leq d < \frac{\phi}{1 - \lambda}. \]

With the assumptions of \( \lambda > 1 - \lambda \) and \( \phi > 0 \), we know that this range exists.\(^{29}\) If either the parties (through contract) or the legal system sets \( d \) such that \( \phi/\lambda \leq d < \phi/(1 - \lambda) \), litigation based on breach of a knowledge-based obligation can produce additional deterrence against the low-type seller from mimicking a high-type seller.\(^{30}\)

5.2. Using Knowledge-Based Obligations in Ex Post Contracts

Knowledge-based obligations can be utilized in many different settings, and we are primarily interested in three possible scenarios. In the first example, we examine its role in an ex post contract to trade. Proposition 3 (as a variation of proposition 1) demonstrates that with appropriately calibrated damages, in equilibrium the buyer will bring suit against the mimicking low-type seller. This allows the parties to reduce both ex ante and ex post inefficiencies.

**Proposition 3.** Suppose there is no ex ante contract at \( t = 0 \), but the parties include a knowledge-based obligation in their contract to trade at \( t = 2 \), under which the buyer can bring suit at \( t = 4 \). Suppose also that, if successful, the buyer will collect damages \( d \), where \( \phi/\lambda \leq d < \phi/(1 - \lambda) \).

The parties' contract will incorporate the optimal quality features with a greater probability—and the seller will make a larger investment—than without such terms. When \( d \) is sufficiently large, the parties can achieve the optimal quality with a probability of 1.

As shown in the proof in Appendix A, when the size of the deterrence (measured by \( \lambda d + \phi \)) is sufficiently large, the parties may be able to achieve the first best. Even with a smaller deterrence, however, a lawsuit based on the good-faith duty or misrepresentation can improve both ex post and ex ante efficiency. Corollary 1 shows that, conditional on any positive litigation cost, when the court’s judgment (regarding whether the

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29. From the inequality of \( \lambda > 1 - \lambda \), when we multiply both sides by \( \phi > 0 \), we get \( \lambda \phi > (1 - \lambda) \phi \), which becomes \( \phi/(1 - \lambda) > \phi/\lambda \).

30. It is relatively straightforward to show that even if \( d \geq \phi/(1 - \lambda) \), the knowledge-based obligation improves ex ante and ex post efficiency, albeit at a larger expected litigation cost.
seller acted in bad faith or misrepresented) is sufficiently accurate, setting the liquidated damages equal to the expectation damages will allow the parties to achieve the first best.

Corollary 1. For any $\phi > 0$, $\exists \lambda \in (\frac{1}{2}, 1]$ such that $\forall \lambda \geq \lambda$, setting $d = v^* - v_1$ achieves the first best. As $\phi$ gets larger, $\lambda$ gets (weakly) smaller.

When the low-type seller mimics the high-type seller and sells the good with expected quality $v_1$ at a price equal to $v^*$, the low-type seller is imposing a negative externality on the buyer, and the size of the negative externality is measured by the difference in valuation: $v^* - v_1$. When the court's judgment is sufficiently accurate, the low-type seller fully internalizes the negative externality, thereby deterring inefficient bargaining behavior.

At the same time, proposition 3 and corollary 1 also demonstrate that damages based on reliance would provide insufficient deterrence unless such damages happen to satisfy $\phi/\lambda < d < \phi/(1 - \lambda)$. We have assumed so far that the buyer has incurred no reliance cost, and of course setting damages equal to 0 would provide no deterrence. Even if reliance expenditure is positive, there is no a priori reason to think that the damages will fall within the range or approximate expectation damages. Finally, while we have assumed that the parties are liquidating the damages, if the court can verify, even at cost and possibly with error, the buyer's valuation $v$, it should grant expectation damages (rather than reliance or any other damages) as the remedy for breach of duty to negotiate in good faith. In proposition 4 (as a variation of proposition 2), we examine the setting in which the parties enter into a binding preinvestment contract to trade that includes an obligation to renegotiate or modify in good faith.

31. Although we mention restitution damages, with the assumption that the buyer's valuation $v$ and the seller's cost $c$ are nonverifiable, the damages may be difficult to calculate; presumably the damages would be equal to realized value for the buyer minus the price. If there is a market value (which is less than the buyer's value), that can be used to approximate restitution damages.

32. Reliance damages can, however, make the buyer more willing to enter into the transaction. Suppose the buyer were to incur some expenditure before the second-stage negotiation begins. Because her expenditure has been sunk by then, the seller, using his bargaining power, will be able to extract all the surplus from the transaction. This implies, in turn, that the buyer will realize a negative profit in the long run and would be unwilling to enter into the negotiation with the seller. By allowing the buyer to recover these costs through reliance damages, now she can be assured that she will at least break even.
5.3. Ex Ante Good-Faith Obligations in Contracts to Trade

In proposition 2, we assumed that when the parties were renegotiating a preinvestment contract, there was no duty to negotiate in good faith. While the assumption was made for the sake of comparison, this was not entirely correct. In fact, contract law polices the bargaining of modifications and may require that it be done in good faith, which includes honesty in fact.\(^{33}\) The conventional justification for the regulation of modifications is the holdup concern rather than ex post efficiency. In our model, misrepresenting one’s type in such renegotiation would presumably constitute bad faith because it would impede ex post and ex ante efficiency. As reflected in proposition 2, and in a manner similar to the result in proposition 3, the requirement of good faith in modification improves both ex ante and ex post efficiency.\(^{34}\)

Proposition 4. Suppose the parties enter into a trade contract at \(t = 0\) that also imposes a duty to renegotiate in good faith. The provision allows the buyer to bring suit after the contract has been modified at \(t = 2\). The parties will be (weakly) better off than if the initial contract did not include such duty.

In corollary 2, we compare the two regimes of imposing knowledge-based liability in the postinvestment contract (proposition 3) and a good-faith renegotiation obligation in a preinvestment contract to trade (proposition 4). Recall that in both regimes, the buyer is entitled to receive damages \(d\) after the seller has delivered a product and the buyer successfully argues that either the seller misrepresented (proposition 3) or acted in bad faith (proposition 4). An important difference is that, in the latter, the parties were renegotiating a binding preinvestment contract to trade.

Corollary 2. Compare the two regimes of knowledge-based duty in

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33. The Uniform Commercial Code (sec. 2-209, comment 2) describes this obligation. The common law has a similar obligation, though it is somewhat differently expressed. For a modification to be enforceable, the modification has to be “fair and equitable in view of circumstances not anticipated by the parties when the contract was made” (Restatement [Second] of Contracts, sec. 89). While there could be some meaningful differences between the standards of the Second Restatement and the Uniform Commercial Code, we assume that the court will find relevance in the seller’s knowledge and intent under both good-faith and fair-and-equitable analyses.

34. As an interesting contrast to the disputes that arise out of preliminary agreements, modification issues generally arise when one of the parties refuses to perform in accordance with the modified terms rather than after the parties have failed to modify the contract.
a postinvestment contract (without a previous contract) and good-faith duty in a preinvestment contract to trade entered into at \( t = 0 \). If \( (v_0 - c_0)/(v* - c_1 - \lambda d - \phi) \geq 1 \), the parties are indifferent between the two regimes, whereas if \( (v_0 - c_0)/(v* - c_1 - \lambda d - \phi) < 1 \), the parties strictly prefer the first regime. As the cost of verification gets smaller \( (\phi \to 0) \), the parties are more likely to strictly prefer the first regime. As the court becomes more accurate \( (\lambda \to 1) \), the parties become indifferent between the two regimes.

Corollary 2 demonstrates that, though the knowledge-based liability can substantially mitigate the problems of opportunism, the obligation is less effective when regulating the modification of a preinvestment contract to trade than when included in a postinvestment contract. When there is no preinvestment contract, the seller has no profitable default contract to fall back on, and the consequent higher private cost of bargaining failure reinforces the incentive effect of the obligation to negotiate in good faith. When the parties have an earlier preinvestment contract that they may modify, however, the deterrence work done by the good-faith obligation is partially undone by the informed seller's opportunism. Unless the deterrence (measured by \( \lambda d + \phi \)) is sufficiently strong, the parties will strictly prefer not to have a preinvestment contract. They may memorialize some or all of the transactional terms, but they would prefer that they not be legally binding. The residual inefficiency might be addressed by agreeing to negotiate in good faith, as described in Section 5.4.

5.4. Good-Faith Obligations in Preliminary Nonbinding Agreements

As a number of contract scholars have noted, the terms of a contract are features of the trade that contribute to the contract surplus, alongside the physical features. The buyer of a good pays for its physical attributes, the contract warranty and the forum-selection clause. Like any other feature, a contract provision might be optimal when the cost to one party is outweighed by the value to the other. One of the recognized functions of contract and commercial law is to provide default provisions and allow parties to opt out when their circumstances indicate that alternative terms would be preferable. In fashion analogous to the seller's investment in
finding the optimal physical attributes of goods, the seller may invest in determining the optimal package of contract provisions. The ex post and ex ante inefficiencies examined in this paper would apply to this process, just as they apply to the physical features.

Contracting parties often agree to negotiate the details of their agreement in good faith, and this obligation highlights the limited effectiveness of other contract mechanisms in addressing related information asymmetries. Consider, for example, a warranty provision. The default warranties for sales of goods are provided in article 2 of the Uniform Commercial Code. A seller can offer broader warranties at a higher cost in return for a higher price, particularly if the incremental value to the buyer exceeds the incremental cost to the seller. Similarly, the seller can limit warranties, particularly if his cost saving in doing so exceeds the incremental loss of value to the buyer. While a warranty can provide insurance against malfunction of the physical attributes and compensate the buyer for her lost expectation, there is no analogous term that ensures the buyer of the value of the warranty itself (like a warranty that a warranty will convey a certain value). Thus, it is difficult to imagine a provision that would be included contemporaneously in the final contract to back the value of other contract terms. It is difficult to imagine a warranty that a forum-selection clause is worth at least the price paid for it by the buyer. The downsides to an ordinary warranty stemming from the stochasticity of the outcome would apply even more with respect to a contract term. The good-faith duty, therefore, may be a useful tool by conditioning instead on the seller's knowledge.

So far, we have examined knowledge-based obligations in binding contracts to trade, either ex ante at $t = 0$ or ex post at $t = 2$. As a third option, instead of using a fully binding agreement, the parties may decide to address the inefficiencies stemming from the seller's private information by agreeing only to negotiate (or bargain) in good faith toward a contract. Contract law recognizes and enforces such a naked mutual promise that is not part of a contract to trade and may be included in an otherwise nonbinding preliminary agreement. In our model, as we saw in proposition 4, this duty to negotiate in good faith would be breached when the low-type seller—who in fact chose the quality attributes at random—mimics the high-type seller to the buyer (or, equivalently, misrepresents that he is a high-type seller). In most disputes that arise out of preliminary agreements with the obligation to negotiate in good faith, the disappointed party brings suit after the negotiation falls apart. In our
model, the negotiations break down when the buyer rejects the seller's take-it-or-leave-it offer. The presence of a good-faith-negotiation term allows the buyer to recover damages from the seller when she, at $t = 3$, realizes (observes) that the (low-type) seller made a bad faith offer at $t = 2$ simply to extract more surplus. The assumption that the court can examine the seller's behavior, such as whether he knew what the optimal terms for the buyer were (honesty in fact) and whether he made an opportunistic offer (unfair dealing) to the buyer allows the possibility for the buyer to bring suit even when there is no contract to trade.\textsuperscript{36}

Proposition 5. Suppose the parties do not enter into a binding preinvestment agreement (at $t = 0$) but agree to be bound by an obligation to negotiate in good faith. Suppose the buyer can bring suit after the negotiation falls apart (at $t = 4$) to collect $d$, where $\phi/\lambda \leq d < \phi/(1 - \lambda)$. The parties implement the optimal term with a strictly larger probability than in the absence of a good-faith obligation. The seller also makes a larger but still suboptimal relationship-specific investment.

Proposition 5 shows how the parties can invoke a duty to negotiate in good faith while deferring entering into a binding contract to trade, so as to minimize the (low-type) seller's opportunism. Even though litigation is costly and the court is prone to make an error, properly calibrated damages can push the unnecessary litigation off the equilibrium and provide deterrence against the low-type seller's mimicking. Unfortunately, however, even very large damages ($d \gg 0$) cannot completely deter a low-type seller's opportunism and therefore cannot achieve the first best. The proof in Appendix A shows that when the low-type seller makes a bad-faith mimicking offer, he still has a chance of getting away with a larger profit (of $v^* - c_1 > v_0 - c_0$) if the buyer accepts the offer with a positive probability and cannot sue the seller to recover the difference in valuation. To deter this residual amount of opportunism, the buyer must reject the high-price renegotiation offer ($p = v^*$), and the parties will suffer some renegotiation failure. This ex post inefficiency also translates to some ex ante inefficiency.

\textsuperscript{36} The assumption that the buyer is able to uncover the seller's behavior (in particular, his knowledge or his type) after the negotiation falls apart can be strong. If the buyer cannot observe the seller's type, she would decide to bring suit on the basis of her belief about which type of seller she faced in the renegotiation stage. In Appendix B, we relax this assumption.
Section 5 demonstrates how knowledge-based obligations can mitigate the renegotiation failure that arises from ex post asymmetric information. Throughout the analysis, we have assumed that while the buyer observes the realized value $v$ of the delivered product, it is not verifiable, and therefore the parties cannot contract on the realized value. A primary reason for this assumption is to focus more on knowledge-based obligations and, in the process, explain the puzzle over why contracting parties and the law impose such obligations (such as the duty to negotiate in good faith) in real-world contracts. The simplifying assumptions of the model, including the fact that the buyer observes the realized value, raise the possibility that the parties may be able to tackle both ex ante and ex post inefficiencies through an option contract, which gives the buyer the right to return the product, instead of relying on a knowledge-based obligation in the contract. For instance, the contract could expressly allow the buyer to return the product (or terminate it) and receive a stipulated refund from the seller.37 While relying on such an option contract can potentially mitigate both ex ante and ex post inefficiencies in certain settings, in many others such a solution may not be readily feasible. Here we highlight three potential obstacles.

First, granting the buyer an option to return the good (or terminate the contract) for a refund may not be feasible in transactions involving experience goods or services. When a contractor is providing an architectural blueprint or an advertising campaign to a client, for instance, it may be very difficult for the client to observe the value of the service until it has been implemented, for example, the building has been constructed or the advertising campaign has run. Another problem is the buyer’s opportunistic use of termination right. Knowing that she has the right to terminate and receive a refund from the seller, even after the (high-type) seller has fully satisfied the contractual obligations, the buyer can now attempt to hold the seller up by threatening to terminate the contract. When both parties observe the realized value $v$, they may be able to renegotiate around this inefficient termination, but such renegotiation will reduce the

37. We thank the referee for making this suggestion. In contract theory studies, several scholars suggest the possibility of using an option (or terminable) contract to tackle the ex ante investment problem. Nöldeke and Schmidt (1995) examine giving the seller an option over delivery, while Stremitzer (2012) and Brooks and Stremitzer (2011) analyze giving the buyer an option to seek specific performance or restitution.
seller's return, which will in turn lower his investment incentive. The final problem stems from the buyer's private information about the product's realized value. Although we have relied on a simplifying assumption that both the buyer and the seller can observe the realized value \( v \), we earlier noted the possibility that while the seller's investment increases the value for the buyer, the realized value is subject to some error that may be known later only to the buyer. In such a scenario, a simple option contract will not implement the efficient outcome because the seller does not know whether the buyer is returning the good (or terminating the contract) because the realized value is low or because of opportunism.

6. CONCLUSION

This paper seeks to analyze the challenges faced by contracting parties when relationship-specific investment yields ex post private information. Foremost, we have shown why contracting parties would generally prefer a postinvestment over a preinvestment contract under these conditions. This provides an explanation for why specific investments are frequently made without contracts and why preliminary agreements to trade are often expressly not binding, even though parties may subsequently make relationship-specific investments. Conventional scholarship would expect the parties to enter into a binding agreement to protect such investment from holdup. In addition, we show how the duty to negotiate in good faith and other knowledge-based promises can deter the informed party's opportunism and provide better ex ante investment incentive. In the process, we have adopted an imperfect verification system under which verification is costly and the court is prone to make an error. As an extension, we also show that when the court can sufficiently accurately calculate expectation damages, granting such damages can lead to the first best. This is because the expectation damages force the opportunistic party to inter-

38. To eliminate the possible opportunistic termination, the parties can attempt to make the initial contract renegotiation proof. Given that the buyer will be able to capture some surplus through opportunistic renegotiation (unless she has no bargaining power), to make the initial contract renegotiation proof she will have to earn some surplus (at least as much as she would have gotten through termination) through a lower price. This will, in turn, reduce the investment incentive for the seller. More detailed analysis is available from the authors.

39. This problem is similar to that of the buyer having to bring a knowledge-based lawsuit against the seller after the renegotiation has fallen apart, since in such a case she may need to bring suit without knowing fully that the seller is the low type. Appendix B provides a more detailed analysis.
nalize the negative externality. By incorporating imperfect renegotiation (due to asymmetric information) and imperfect verification (due to litigation cost and error), we have attempted to add more nuanced perspective to the extant incomplete-contract literature that relies on the assumptions of perfect renegotiation and nonverifiability.

APPENDIX A: PROOFS

Proof of Proposition 1

The analysis follows closely the proofs in Choi (2007, 2017). As is typical, we work backward from the negotiation stage to the investment stage. Also, in these types of games, because the high-type seller makes a larger profit than the low-type seller (in equilibrium), we need to make sure that the low-type seller does not want to mimic the high-type seller. Given that there is no initial binding agreement between the parties, at \( t = 2 \) suppose the high-type seller, who has discovered the optimal terms \((q^*)\) offers \((v^*, q^*)\) to the buyer, and the buyer accepts that offer with a probability of \( \gamma \in [0, 1] \). Suppose, at the same time, if the seller were to make the default offer \((p_0, q_0)\), the buyer accepts that offer with a probability of 1 (which will maximize the efficiency). For the high-type seller to be making this offer instead of sticking with the default terms \( k_0 = (v_0, q_0) \), it must be the case that \( \gamma (v^* - c^*) \geq v_0 - c_0 \), or

\[
\gamma \geq \frac{v_0 - c_0}{v^* - c^*}.
\]

On the other hand, for the low-type seller to make the offer \((v_0, q_0)\), it must be the case that \( v_0 - c_0 \geq \gamma (v^* - c_1) \), or

\[
\gamma \leq \frac{v_0 - c_0}{v^* - c_1}.
\]

Given that \( c^* < c_1 \) and \( v^* - c^* > v_0 - c_0 \), we can find a \( \gamma \) that satisfies both conditions:

\[
\frac{v_0 - c_0}{v^* - c^*} \leq \gamma \leq \frac{v_0 - c_0}{v^* - c_1}.
\]

Note that since \( v^* - c_1 > v_0 - c_0 \), we get \( (v_0 - c_0)/(v^* - c_1) < 1 \). Furthermore, since \( v^* - c^* > v^* - c_1 \), we get \( (v_0 - c_0)/(v^* - c^*) < (v_0 - c_0)/(v^* - c_1) \). If we were to focus on the largest possible \( \gamma \), so as to maximize efficiency, in equilibrium the buyer will accept the offer \((v^*, q^*)\) with a probability of \( \gamma = (v_0 - c_0)/(v^* - c_1) \) while accepting the offer \((v_0, q_0)\) with a probability of 1.

40. If this condition is not satisfied, the high-type buyer would rather choose one of the additional attributes at random and still offer the high price \( v^* \). This will, in turn, undermine the seller’s investment incentive.
Finally, let us examine the seller’s investment incentive as of \( t = 1 \). Conditional on \( l_s \), the seller rationally expects that he will discover the optimal terms with a probability of \( \alpha(l_s) \) and discover nothing with a probability of \( 1 - \alpha(l_s) \), and the buyer will accept \((v^*, q^*)\) with a probability of \( \gamma = (v_0 - c_0)/(v^* - c_1) < 1 \) and will accept \((v_0, q_0)\) with a probability of 1. The seller’s expected profit, as of \( t = 1 \), is given by

\[
\alpha(l_s)[\gamma(v^* - c^*)] + [1 - \alpha(l_s)](v_0 - c_0) - \psi(l_s).
\]

The first-order condition is given by

\[
\alpha'(l_s)[\gamma(v^* - c^*) - (v_0 - c_0)] = \psi'(l_s).
\]

Since \( v^* - c^* > v^* - c_1, v^* - c^* > \gamma(v^* - c^*) > v_0 - c_0 \). Hence, the seller makes a strictly positive but suboptimal investment: \( 0 < l_s < l_s^* \). Q.E.D.

**Proof of Proposition 2**

Similar to the proof of proposition 1, at the renegotiation stage \( (t = 2) \) imagine that the high-type seller makes the offer \( p = v^* \) and \( q = q^* \). Suppose also that the buyer accepts this offer with a probability of \( \beta \in [0, 1] \). The low-type seller can either make a renegotiation offer of \( p = v^* \) and \( q = \hat{q} \in \{q_1, \ldots, q_F\} \) (because he does not know the optimal attribute) and pretend that this is optimal for the buyer or not make a renegotiation offer and stay with the default terms. The low-type seller will have the incentive to mimic the high-type seller. If he were to remain with the default terms, he will realize a profit of \( p_0 - c_0 = v_0 - c_0 \). If he were to make a renegotiation offer, pretending to be a high-type seller, he would realize a profit of

\[
\beta(v^* - c_1) + (1 - \beta)(v_0 - c_0).
\]

That is, with a probability of \( \beta \) the buyer would accept the renegotiation offer, which would yield a profit of \( v^* - c_1 \) to the low-type seller, and with a probability of \( 1 - \beta \), the buyer would reject the offer, which would leave the low-type seller with a profit of \( v_0 - c_0 \). Since \( v^* - c_1 > v^* - c_0 \), we get

\[
\beta(v^* - c_1) + (1 - \beta)(v_0 - c_0) > v_0 - c_0 \quad \forall \beta > 0.
\]

In other words, if the buyer were to accept the renegotiation offer with a positive probability, it is strictly better for the low-type seller to mimic the high-type seller. The buyer faces the possibility of a randomly chosen feature by the low-type seller that will yield a loss in expectation (because of the presence of the worst option \( j^{**} \)) and otherwise of the high-type contract in which the buyer enjoys only an \( \varepsilon \) of the surplus. So the buyer will be strictly better off by not accepting the renego-

41. If this condition is not satisfied, the low-type seller has no incentive to mimic the high-type seller, and full ex post efficiency would result. For instance, given that \( c_1 > c_0 \), if \( v^* \leq v_0 \), the low-type seller has no incentive to mimic the high-type seller by offering a lower price to the buyer.
tiation offer: setting β = 0.42 Given that the buyer will always reject, the seller has no incentive at t = 2 to make an investment to discover the optimal terms. Q.E.D.

**Proof of Proposition 3**

As in the case with no preinvestment agreement to trade (proposition 1), let us construct and focus on a separating equilibrium in which the high-type seller offers \((v^*, q^*)\), the low-type seller offers \((v_0, q_0)\), and the buyer accepts \((v_0, q_0)\) with a probability of 1 while accepting \((v^*, q^*)\) with a probability of \(δ \in [0, 1]\). Looking at the stage \(t = 3\), for the high-type seller to offer \((v^*, q^*)\), it must be the case that \(δ(v^* - c^*) \geq v_0 - c_0\). While the buyer has an option of bringing litigation against the seller at \(t = 4\), the high-type seller knows that because \(\phi/λ < d < \phi/(1- λ)\), she has an insufficient incentive to bring suit.

For the low-type seller, however, the story is different, since he knows that if he were to mimic the high-type seller and the buyer were to accept, he will face a (misrepresentation) lawsuit by the buyer to collect \(d\) at \(t = 4\). With that litigation possibility in mind, for the low-type seller to offer \((v_0, q_0)\), it must be the case that

\[
v_0 - c_0 \geq \delta(v^* - c_1 - λd - ϕ).
\]

The right-hand side of the inequality represents the low-type seller’s expected return from mimicking the high-type seller. Note that, compared with the case of no preinvestment binding agreement to trade, the expected return is lowered (in the parentheses) by the expected loss from litigation \((λd + ϕ)\). To achieve separation, therefore, it must be the case that

\[
\frac{v_0 - c_0}{v^* - c^*} \leq δ \leq \frac{v_0 - c_0}{v^* - c_1 - λd - ϕ}.
\]

Recall that in the case of no preinvestment agreement to trade, the comparable inequalities are given by \((v_0 - c_0)/(v^* - c^*) \leq γ \leq (v_0 - c_0)/(v^* - c_1)\). While the left-hand side is the same, now the right-hand side is strictly larger (since \(λd + ϕ > 0\)). Hence, the buyer can accept the \((v^*, q^*)\) offer with a higher probability. Furthermore, depending on the parameters, it may be feasible to have \((v_0 - c_0)/(v^* - c_1 - λd - ϕ) \geq 1\), in which case the buyer can accept the \((v^*, q^*)\) offer with a probability of 1 (\(δ = 1\)). Q.E.D.

**Proof of Corollary 1**

Suppose the parties set \(d = (v^* - v_1)\), which is the value of the expectation damages. From proposition 3, to prevent the low-type seller from mimicking the high-type seller, we need to satisfy

\[
v_0 - c_0 \geq \delta(v^* - c_1 - λd - ϕ).
\]

42. We include a regularity condition later so that the pooling equilibrium, in which both the high-type seller and the low-type seller get to renegotiate, will not be feasible. Even if it were, this leads to other inefficiencies.
Also, implementing the first best implies that in equilibrium \( \delta = 1 \). When we substitute these expressions in the inequality, we get

\[
\phi \geq (v^* - c_1) - (v_0 - c_0) - \lambda(v^* - v_1).
\]

When we differentiate the right-hand side of the inequality with respect to \( \lambda \), we get

\[
-(v^* - v_1) < 0.
\]

Hence, the right-hand side is strictly decreasing with respect to \( \lambda \). When \( \lambda = 1 \), the right-hand side becomes

\[
(v_1 - c_1) - (v_0 - c_0)
\]

which may be positive or negative. If it is negative, given that \( \phi > 0 \), the inequality will be strictly satisfied \( \forall \lambda \in (\frac{1}{2}, 1] \).

Suppose that \( \frac{1}{2}(v^* - v_1) + (v_1 - c_1) - (v_0 - c_0) > 0 \). As \( \phi \to 0 \), to satisfy the inequality it must be the case that \( (v^* - c_1) - (v_0 - c_0) - \lambda(v^* - v_1) \leq 0 \). When

\[
\lambda \geq \frac{\phi}{\lambda} = \frac{1}{2}(v^* - c_1) - (v_0 - c_0)
\]

then we know that even with \( \phi = 0 \), the inequality is at least weakly satisfied. Since \( (v^* - c_1) - (v_0 - c_0) - \lambda(v^* - v_1) < 0 \) when \( \lambda = 1 \), we know that \( [(v^* - c_1) - (v_0 - c_0)]/(v^* - v_1) < 1 \). More generally, this is true for

\[
\lambda(\phi) = [(v^* - c_1) - (v_0 - c_0) - \phi]/(v^* - v_1).
\]

From that expression, we see that as \( \phi \) gets larger, \( \lambda \) gets smaller.

With \( \delta = 1 \), the parties manage to achieve ex post efficiency. Furthermore, the seller’s expected profit as of \( t = 2 \) becomes

\[
\alpha(l_0)(v^* - c^*) + [1 - \alpha(l_0)](v_0 - c_0) - \phi(l_0).
\]

Note that this is the same as the social planner’s objective function. From this, we see that the seller will also choose \( l_0 = l^p \), thereby achieving ex ante efficiency.

Q.E.D.

**Proof of Proposition 4**

As in the context of nonbinding agreement, suppose the buyer can bring suit against the seller to collect \( d \) after the parties have modified the contract. Suppose also that \( d \) is set so that

\[
\frac{\phi}{\lambda} \leq d < \frac{\phi}{1 - \lambda}.
\]

We construct a separating equilibrium in which the high-type seller offers to modify the contract to \( (v^*, q^*) \), the low-type seller does not make a modification offer, and the buyer accepts the \( (v^*, q^*) \) modification offer with a probability of \( \beta \in [0, 1] \). With regard to the renegotiation stage \( t = 3 \), for the high-type seller to offer \( (v^*, q^*) \), it must be the case that \( \beta(v^* - c^*) + (1 - \beta)(v_0 - c_0) \geq v_0 - c_0 \). Note that this is trivially satisfied since, by assumption, \( v^* - c^* > v_0 - c_0 \). While there is a possibility of litigation at \( t = 4 \) because \( \phi(\lambda) \leq d < \phi(1 - \lambda) \), the high-type seller knows that the buyer has an insufficient incentive to bring suit.

The low-type seller knows that if he were to mimic the high-type seller and the buyer were to accept, he will face a lawsuit by the buyer to collect \( d \) at \( t = 4 \). With
that in mind, for the low-type seller to not make a modification offer and stay with \((v_0, q_0)\), it must be the case that

\[ v_0 - c_0 \geq \beta(v^* - c_1 - \lambda d - \phi) + (1 - \beta)(v_0 - c_0). \]

Note that the first expression on the right-hand side decreases the seller’s expected return by the expected total cost of litigation \((\lambda d + \phi)\). Since we have \(v_0 - c_0\) on both sides of the expression, to satisfy the inequality and achieve separation, it must be the case that \(v^* - c_1 - \lambda d - \phi \leq v_0 - c_0\) or

\[ \frac{v_0 - c_0}{v^* - c_1 - \lambda d - \phi} \geq 1. \]

If the inequality is (strictly) satisfied, the parties can achieve full separation, in which the high-type seller makes a modification offer of \((v^*, q^*)\), the low-type seller does not attempt to modify the contract (that is, makes no renegotiation offer), and the buyer accepts the modification offer \((v^*, q^*)\) with a probability of 1. If, on the other hand, \((v_0 - c_0)/(v^* - c_1 - \lambda d - \phi) < 1\), we are back to the initial setting with no renegotiation, in which the buyer always rejects the seller’s renegotiation offer, and the parties always trade under the initial terms \((v_0, q_0)\). Q.E.D.

**Proof of Corollary 2**

Let us compare the results from the regime that imposes the obligation to negotiate in good faith with a binding initial agreement and those from the regime that imposes the knowledge-based liability with a nonbinding initial agreement. These are the results from propositions 3 and 4, respectively.

We saw earlier that in the no-initial-agreement regime (proposition 3), if \((v_0 - c_0)/(v^* - c_1 - \lambda d - \phi) \geq 1\), we achieved full separation and the first-best outcome, as the buyer always accepts the high-type seller’s offer \((v^*, q^*)\) and the low-type seller’s offer \((v_0, q_0)\). Comparing these two legal regimes, when \((v_0 - c_0)/(v^* - c_1 - \lambda d - \phi) \geq 1\), we get the equivalent outcome. Hence, the parties will be indifferent between the two regimes.

When \((v_0 - c_0)/(v^* - c_1 - \lambda d - \phi) < 1\), with a binding initial agreement (and the obligation to negotiate in good faith) separation is not feasible, and both types of seller trade with the buyer under the default terms: \((v_0, q_0)\). In equilibrium, they realize a surplus of \((v_0 - c_0)\). With a nonbinding initial agreement (and an obligation to negotiate in good faith), in an efficient separating equilibrium the high-type seller offers \((v^*, q^*)\), which is accepted with a probability of \(\delta = (v_0 - c_0)/(v^* - c_1 - \lambda d - \phi) < 1\), while the low-type seller offers \((v_0, q_0)\), which is always accepted. In equilibrium, they realize a surplus of \(\alpha(l_\delta)(v^* - c^*) + [1 - \alpha(l_\delta)](v_0 - c_0) - \psi(l_\delta)\). This is greater than \((v_0 - c_0)\) since \(\delta(v^* - c^*) \geq (v_0 - c_0)\). Hence, when \((v_0 - c_0)/(v^* - c_1 - \lambda d - \phi) < 1\), the parties will strictly prefer the non-binding-agreement regime.
In terms of comparative statics, since $\phi/(1 - \lambda) < d < \phi/(1 - \lambda)$, we get $2\phi \leq \lambda d + \phi < \phi/(1 - \lambda)$. When we examine the upper and lower bounds on $\lambda d + \phi$, we see that $\phi \rightarrow 0$, $\phi/(1 - \lambda) \rightarrow 0$, and $2\phi \rightarrow 0$. This renders $(v_0 - c_0)/(v^* - c_1) - \lambda d - \phi) < 1$. On the other hand, as $\lambda \rightarrow 1$, $\phi/(1 - \lambda) \rightarrow \infty$, and $2\phi$ remains constant. With a sufficiently large $\lambda$, therefore, we can easily find $d$ such that $(v_0 - c_0)/(v^* - c_1 - \lambda d - \phi) > 1$. This implies that as the cost of litigation gets smaller $(\phi \rightarrow 0)$, the parties are more likely to prefer the non-binding-agreement regime (with an obligation to negotiate in good faith). As the court becomes more accurate in its determination $(\lambda \rightarrow 1)$, the parties are more likely to become indifferent between the two regimes. Q.E.D.

**Proof of Proposition 5**

This proof is largely similar to that for proposition 3. At $t = 2$, if the low-type seller were to mimic the high-type seller and offer $(v^*, q)$, the seller would expect to realize a profit of

$$\delta (v^* - c_1) - (1 - \delta)(\lambda d + \phi).$$

The second expression represents the fact that in case the buyer rejects the renegotiation offer from the low-type seller, she is able to collect damages $d$ with a probability of $\lambda$. At the same time, the first expression assumes that when the low-type seller mimics the high-type seller (and offers $p = v^*$) and the buyer accepts the offer, she does not have any legal remedy against the mimicking seller, and the low-type seller gets to walk away with a profit of $v^* - c_1$ (while the buyer is getting only a widget of value $v < v^*$).

For the low-type seller to be truthful and offer $(v_o, q_o)$, it must be the case that $v_0 - c_0 \geq \delta (v^* - c_1) - (1 - \delta)(\lambda d + \phi)$. When we simplify the expression, we get

$$\delta \leq \frac{v_0 - c_0 + (\lambda d + \phi)}{v^* - c_1 + (\lambda d + \phi)}.$$

Since $\lambda d + \phi > 0$, we know that $\frac{v_0 - c_0 + (\lambda d + \phi)}{v^* - c_1 + (\lambda d + \phi)} > 1$, and in equilibrium there will be some ex post inefficiency. The reason stems from the fact that even when $\lambda d + \phi$ is very large, so as to make it unattractive for the low-type seller to mimic the high-type seller, when the buyer accepts the high-price offer $p = v^*$ with a positive probability $(p \delta)$, given that the buyer has no legal remedy against the seller when the offer is accepted, the low-type seller may still be able to walk away with some positive profit. This, in turn, requires the buyer to reject the high-price offer with some positive probability (that is, $\delta < 1$).
Finally, with respect to investment efficiency, the seller’s first-order condition is given by
\[ \alpha'(l_t)\{\delta(v^* - c^*) - (v_0 - c_0)\} = \psi'(l_t). \]
Given that \( \gamma < \delta < 1 \), we know that the seller will make a strictly larger investment, compared with the case with nonbinding initial agreement (without the obligation to negotiate in good faith). But the investment will still be suboptimal.

**APPENDIX B: WHEN THE BUYER DOES NOT DISCOVER THE SELLER’S TYPE EX POST**

When we were analyzing the obligation to negotiate in good faith, we assumed that before bringing suit the buyer uncovered the seller’s type and behavior. For instance, in the analysis for proposition 5, when the low-type seller made a mimicking offer to the buyer, we assumed that the buyer became aware of this fact after the renegotiation fell apart. The buyer’s ex post knowledge allowed the parties to calibrate the damages so as to screen meritorious lawsuits from nonmeritorious ones. In certain settings, however, it may be unrealistic to assume that the buyer is aware of how the seller behaved in renegotiation, for example, whether he was dishonest with respect to the value that the proposed widget would contribute to the trade. If the buyer is unaware, we may no longer be able to get the benefit of perfect ex post screening. However, even without the buyer’s ex post knowledge, the analysis shows that the obligation to negotiate in good faith can still facilitate better ex post and ex ante incentives.

Return to the setting for proposition 5. Suppose instead that after the renegotiation falls apart, the buyer does not know whether the rejected offer came from the high-type seller or the low-type seller. At the same time, given that the initial agreement imposed the obligation to negotiate in good faith, the buyer can decide to bring suit, alleging breach of obligation to negotiate in good faith. If the defendant is the high-type seller, the buyer wins \( d \) with a probability of \( 1 - \lambda \), and if the defendant is the low-type seller, the buyer prevails with a probability of \( \lambda \). In other words, even though the buyer is not aware of the seller’s type, through discovery the court will identify with certain probability his correct type. As before, both parties incur the litigation cost \( \phi \).

Consistent with the earlier analysis, let us construct a separating equilibrium under which each type of seller makes a different renegotiation offer. Given that the buyer does not observe the seller’s type and that there is a full separation in equilibrium, for the obligation to negotiate in good faith (and the attendant lawsuit) to play a role, the buyer must have a (at least weakly) credible litigation threat against the high-type seller: \((1 - \lambda)d - \phi \geq 0\). Suppose this weak inequality
is satisfied. Now suppose the seller can offer \( p > v_0 \), and the buyer rejects the offer with a probability of \( \delta \in [0, 1] \). If the high-type seller were to make this offer (with the optimal attributes of \( q^* \)), his expected profit would be

\[
\delta(p - c_*) - (1 - \delta)(1 - \lambda)d + \phi.
\]

Note that now there is a second term indicating that in case the renegotiation falls apart, the buyer will bring suit against the seller and the seller will incur a loss, in expectation, of \((1 - \lambda)d + \phi \). If the low-type seller were to mimic the high-type seller, his expected profit would be

\[
\delta(p - c_1) - (1 - \delta)(\lambda d + \phi).
\]

To make sure that the high-type seller offers \( p > v_0 \) while the low-type seller offers \( p = v_0 \), it must be the case that

\[
\delta(p - c_*) - (1 - \delta)(1 - \lambda)d + \phi \geq (v_0 - c_0) \geq \delta(p - c_1) - (1 - \delta)(\lambda d + \phi).
\]

Note that since \( c_* < c_1 \) and \( \lambda > 1 - \lambda \), we have \( \delta(p - c_*) - (1 - \delta)(1 - \lambda)d + \phi \geq \delta(p - c_1) - (1 - \delta)(\lambda d + \phi) \). More importantly, we can find a \( \delta \) to satisfy the inequalities. To maximize the contractual surplus (and minimize the renegotiation failure), suppose we let \( (v_0 - c_0) = \delta(p - c_1) - (1 - \delta)(\lambda d + \phi) \). From this, we get

\[
\delta = \frac{(v_0 - c_0) + (\lambda d + \phi)}{(p - c_1) + (\lambda d + \phi)}.
\]

Now let us turn to the buyer's incentive. In a fully separating equilibrium, the high-type seller will offer \( p > v_0 \), while the low-type seller will offer \( p = v_0 \). Rationally expecting this, when the buyer receives an offer of \( p > v_0 \), by accepting she rationally expects to realize a profit of \( v^* - p \). If the buyer rejects, she will bring suit against the seller and realize an expected return of \((1 - \lambda)d - \phi \geq 0 \). Given that the buyer has to reject the offer \( p > v_0 \) with a positive probability, she must be indifferent between the two outcomes. It must be the case that

\[
v^* - p = (1 - \lambda)d - \phi.
\]

From the equality, we get \( p = v^* - [(1 - \lambda)d - \phi] \), and we see that damages \( d \) and the high-type seller's price \( p \) are inversely related. Also, when we combine this expression with the expression for \( \delta \), we get

\[
\delta = \frac{(v_0 - c_0) + (\lambda d + \phi)}{(v^* - c_1) + (\lambda d + \phi) - [(1 - \lambda)d - \phi]}.
\]

43. If this weak inequality is not satisfied, there are two possibilities. In the first, the buyer never brings suit against the seller, in which case we are back to the initial analysis without the duty to negotiate in good faith. The second possibility is more complex. It is possible for the low-type seller to mix his strategy between offering high price and low price and the buyer to mix her strategy in terms of bringing and not bringing litigation.
Since \( v^* - c_1 > v_0 - c_0 \), when \((1 - \lambda)d - \phi = 0\), we get \( \delta < 1 \). It is clear that as \( d \) rises, \( \delta \) decreases.

The minimum value for damages we need is given by the credibility constraint \((1 - \lambda)d - \phi \geq 0\). From this, we get the lower bound on \( d \) of \( d = \phi / (1 - \lambda) \). With \( d = \phi(1 - \lambda) \), we get \( v^* = p \) and \( \delta < 1 \). With the smallest possible (credible) damages, the high-type seller will be able to extract all the surplus from the buyer, but her acceptance of that offer is not certain. The analysis is analogous to the case without any good-faith litigation. This is not surprising. By setting \( d < \phi(1 - \lambda) \), for instance, the parties are basically taking litigation off the table, and the equilibrium reverts to the one without any obligation to negotiate in good faith.

At the other end of the spectrum, the maximum value of damages we need is given by the maximum probability that the buyer accepts the offer \( p > v_0 \). For this to happen, it must be the case that \((v_0 - c_0) = (v^* - c_1) - [(1 - \lambda)d - \phi]\). From this, we get the maximum \( d \) of \( \bar{d} = [(v^* - c_1) - (v_0 - c_0) + \phi] / (1 - \lambda) \). When \( d = [(v^* - c_1) - (v_0 - c_0) + \phi] / (1 - \lambda) \), we get \( \delta = 1 \) and \( v^* > p \). In this case, we get full ex post efficiency, but the (high-type) seller does not get to capture the full surplus. All along the spectrum, litigation takes place in equilibrium, in which the buyer sues the high-type seller whenever the renegotiation falls apart.

Which type of equilibrium will the high-type seller prefer and satisfy the intuitive criterion? This depends on the size of the surplus and the cost of litigation. From above, the high-type seller’s equilibrium expected profit is given by

\[
\pi_H = \delta(p - c^*) - (1 - \delta)[(1 - \lambda)d + \phi],
\]

with the expressions for \( p \) and \( \delta \) as given above. Assuming that \( d \in [\phi(1 - \lambda), [(v^* - c_1) - (v_0 - c_0) + \phi] / (1 - \lambda)] \), when we differentiate the high-type seller’s expected profit with respect to \( d \), we get

\[
\frac{\partial \pi_H}{\partial d} = \frac{\partial \delta}{\partial d}[(v^* - c^*) + 2\phi] - (1 - \lambda).
\]

Although a bit tedious, it is easy to show algebraically that \( \partial \delta / \partial d > 0 \). Unfortunately, however, given that the second term is negative, a priori it is not entirely clear whether \( \partial \pi_H / \partial d \) is positive or negative.

However, since \((1 - \lambda) < 1/2\), when \((v^* - c^*) + 2\phi\) is sufficiently large, we get \( \partial \pi_H / \partial d > 0 \), in which case the high-type seller will set the damages as high as possible \((d = \bar{d})\) so as to achieve \( \delta = 1 \). This is likely to occur when the size of the surplus \( v^* - c^* \) and/or the cost of litigation \( \phi \) is sufficiently large. In this case, compared with the case without the obligation to negotiate in good faith, the parties will be able to achieve a strictly higher surplus. Given that \( \delta = 1 \), the costly litigation will be pushed off the equilibrium. The ex ante investment incentive will also be higher since the high-type seller is making a larger profit compared with the case with \( d = d \), which is equal to the profit the high-type seller would have gotten without the obligation to negotiate in good faith.
By comparison, when \((v^* - c^*) + 2\phi\) is sufficiently small, the high-type seller will set \(d = d^*\) and make a renegotiation offer of \(p = v^*\). When the potential surplus from the transaction \((v^* - c^*)\) or the cost of litigation \((\phi)\) is sufficiently small, it is better for the high-type seller to try to capture all the surplus from the transaction rather than risk losing the deal. In such a case, being able to impose the obligation to negotiate in good faith does not add value to the contracting parties. The total surplus will be the same as in the case without the obligation to negotiate in good faith.

REFERENCES


