

Endogenous Verifiability and Relational Contracting

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Abstract

Principal-agent models usually invoke the strong assumption that the parties know for sure ex ante whether a variable is verifiable or not. This paper assumes that only the probability of verification is known, and that this probability is endogenously determined. We analyze a principal-agent relationship where the verifiability of the agent's output is determined by the principal's investment in drafting an explicit contract. The model is well suited for analyzing the relationship between explicit contracting, legal courts, trust and relational contracting. In particular we show how trust - established through repeated interaction - and legal courts may induce contractual incompleteness.

For contracting parties it will often be uncertain whether a legal court is able to enforce the real intents of their contract. The strict requirements of verifiability make it costly, if not impossible, for parties to arrange their transactions and design their contract in a way that makes it completely protected by the court. A way out

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is then to rely on self-enforcing *relational* contracts. Through repeated transactions the parties can make it costly for each other to breach the contract, by letting breach ruin future trade. But the self-enforcing range of contracts is limited, so the court's ability to enforce a contract is not without consequence for the contracting parties. If possible, the parties may thus have incentives to take costly actions that affect the ability of the court. Both ex ante preparations in terms of detailed contracting, and ex post revelation of information can increase the probability of fair court enforcement. In this paper we focus on the former, assuming that the parties are able to improve the verifiability of the contracted upon actions by careful ex ante contract specifications. We assume that careful contracting can improve the court's ability to verify whether an action conforms with the one described in the contract. Then we ask: What happens to the self-enforcing contract equilibrium if a party takes actions ex ante that affect the probability of verification? In order to give some answers to this question, we analyze a simple repeated principal-agent game where the verifiability of the agent's actions is endogenously determined by the principal's investments in drafting an explicit contract pertaining to the quality of the agent's output.

The model makes it possible to identify some subtle effects of two key enforcement devices: legal courts and repeated interaction. Note that by endogenizing verifiability we also endogenize the degree of contractual incompleteness. And the equilibrium level of incompleteness will depend on the 'verification technology', i.e., the resource costs that are necessary to achieve various verifiability levels. This 'verification technology' will be influenced in an essential way by the quality of courts. In fact, we can use the model to study relationships between two distinct aspects of courts; namely their ability (which influences the verification technology) and their predictability (which manifests itself in the equilibrium level of verifiability, i.e. the probability with which the court in fact will verify the relevant action).

The repeated game approach formalizes an economic concept of trust and trustworthiness since a party honors trust if the present value of honoring exceeds the present value of abusing it. The discount factor is then a proxy for the trust-level in the relationship. By studying the effect of variations in verification technology

and the discount factor, we can thus gain insight into the relationship between court ability, explicit contracting, trust and relational contracting. Below we summarize the results:

Trust and contractual incompleteness: In the debate over the merger between General Motors (GM) and Fisher Body in 1926, some hold that GM acquired Fisher Body because of relationship specific underinvestment (see Benjamin Klein, Robert G. Crawford and Armen A. Alchian, 1978; Oliver Hart, 1995; and Benjamin Klein, 2000). Others oppose this, arguing that the relationship between GM and Fisher Body prior to 1926, exhibited trust rather than underinvestment (see Ramon Casadeus-Masanell and Daniel F. Spulber, 2000; Ronald Coase, 2000; and Robert F. Freeland, 2000). Are these views necessarily incompatible? Cannot underinvestment go hand in hand with trust?

We know that incomplete contracting leads to underinvestment. If contracts are complete, first-best investments can be achieved. Moreover, it appears that trust can be a source of contractual incompleteness: why spend effort in writing a detailed contract with somebody you trust? We show that once we allow for different levels of contractual incompleteness, modeled as endogenously determined probabilities of legal enforcement, the relationship between trust and specific investments in quality is not crystal clear. In fact, quality can be negatively related to trust.

We present two findings along these lines. First, we show that the quality level may be higher in the spot contract equilibrium than in the relational contract equilibrium. This is in sharp contrast to other incomplete contracting models where quality levels are always lower in the spot contract. Second, we show that a higher discount factor in the repeated game may reduce the quality level, a result which is also at variance with other relational contracting models, where specific investment in quality always is a positive function of the discount factor. These results are appealing. To our knowledge, there is no empirical evidence on higher quality levels in repeated relationships than in one shot contractual relationships. This is also noted by W. Bentley MacLeod (2007), who argues that there is no established empirical relationship between reputation and quality.¹ The (anecdotal) evidence

¹Also, Banerjee and Duffo's (2000) study of Indian software suppliers shows that reputation is

on more contractual incompleteness in repeated relationships is, on the other hand, abundant. Consider for instance the typical employment relationship, repeated in nature, and governed by almost no formal contract. Compare this to contractual relationships between firms and independent consultants; which more often involve one shot transactions, but are governed by detailed contracting.

Courts and relational contracts: In an interesting study of the relationship between courts and relational contracts in post communist countries, Simon Johnson, John McMillan and Christopher Woodruff (2002) claim that experience with courts does not provide a good basis for measuring the quality of courts, since courts might be used less frequently the more effective they are. Moreover, they find that "belief in the effectiveness of courts has a significant positive effect on trust shown in new relationships between firms and their customers" (p. 221).

Our model supports their work in that we find an ambiguous relationship between improvements in verification technology, which can be seen as a proxy for improved court quality, and the verifiability level realized in equilibrium. In particular we find that the surplus from better verification technology can be realized through lower contract costs and thus lower verifiability. Hence, high-quality courts may induce more contractual incompleteness. This suggests not only that experience with courts is a poor basis for measuring the quality of courts. It also suggests that the verifiability level, and thus the predictability of the courts, is not a good measure for the courts' ability to verify and enforce contracts. The gain from a 'high ability' court system may be realized through a higher degree of relational contracting rather than a higher degree of explicit contracting.

We also relate these findings to a discussion on contract enforcement in common law vs. civil law. The common law system is traditionally more willing to enforce specific contract terms than civil law, which to a larger extent sets party-designed contract terms aside if they conflict with the civil codes. We argue that these differences can be related to verification technologies and may explain observed differences in equilibrium court decisions in the two systems. In particular we find that equilibrium verifiability levels are expected to be lower in civil law systems.

not associated with the quality of the product itself.

Legal breach remedies: The model may also contribute to our understanding of how legal breach remedies affect the scope of contracting. In this paper we assume that if a contract breach is verified, the court applies either reliance damages (RD) or expectation damages (ED) as breach remedies. Reliance damages entail that the breacher has to compensate the victim such that the latter is no worse off than before the contract was signed, while expectation damages entail that the breacher has to compensate the victim so as to make her equally well off as under contract performance. ED is the most typical remedy, and is also regarded as the most efficient one in the seminal literature on optimal breach remedies (Steven Shavell, 1980; and William P. Rogerson, 1984). But RD is quite common in practice, and the standard explanation for this is that expectation damages are more difficult to assess. We provide a rationale for RD that has not been addressed in the literature on optimal breach remedies: Since RD is shown to yield a lower surplus from spot contracting than ED, the scope of relational contracting (and the associated surplus) may be greater if the parties expect the court to apply RD rather than ED. This result applies more generally; breach remedies that are optimal in a static setting, may be suboptimal in a repeated setting.

Related literature: Most of the existing principal-agent literature assumes at the outset that some variables are verifiable, and thus enforceable by courts, and some are not. Models with costly state verification, starting with Robert M. Townsend (1979), have focused on contract design problems where enforcement and thus verifiability is a decision variable. There is also a literature that examines the relationship between evidence disclosure and verifiability (see e.g., Shingo Ishiguro, 2002; and Jesse Bull and Joel Watson, 2004). But these approaches consider the effect of an ex post possibility to decide whether or not to make a variable verifiable, while we consider ex ante actions that affect the probability of verification. More importantly, these papers do not consider repeated relationships, as we do.

In repeated game models of relational contracts, verifiability is always exogenously given. By definition, a relational contract relies only on self-enforcement; effort variables are non-verifiable, and the parties honor the contract as long as the present value of honoring exceeds the present value of reneging. MacLeod and

James Malcomson (1989) provide a complete treatment of relational contracts with symmetric information where all actions of the agent are non-verifiable. Klaus M. Schmidt and Monica Schnitzer (1995) analyze a repeated relationship where some actions can be verified and some cannot, while George Baker, Robert Gibbons and Kevin J. Murphy (1994) analyze a model with one action generating one verifiable, but imperfect signal and one perfect, but non-verifiable signal. However, the verifiability of a given action or signal is exogenously given in these models.² Somewhat more in line with our work is Pierpaolo Battigalli and Giovanni Maggi (2008), Joel Sobel (2006) and MacLeod (2007), who study the interaction between legal enforcement and self-enforcement in repeated game models of costly contracting. But in Battigalli and Maggi's model the parties know *ex ante* for certain whether an action is verifiable or not. In both Sobel and MacLeod legal enforcement is probabilistic, but the parties do not make a trade-off between quality and the verifiability level, which is a crucial feature of our model

In the costly contracting approach, explicit contracts can be viewed as part of the technology of exchange. A proper level of explicit contracting is part of the efficient solution, i.e. contracts are neither costless to write, as they are in standard principal-agent models, nor are they prohibitively costly, as they are in models of incomplete contracting. In one strand of this literature, starting with Ronald A. Dye (1985), the central issue is to explain and describe the formation of incomplete contracts.³ Another strand sees endogenous contractual incompleteness as a vehicle to understand other aspects of transactional relationships, see in particular Patrick Bajari and Steven Tadelis (2001), Alan Schwartz and Joel Watson (2004),

²Other models that address the relationship between verifiable and non-verifiable variables are B. Douglas Bernheim and Michael D. Whinston (1998), and David G. Pearce and Ennio Stacchetti (1998).

³Explaining endogenous contract incompleteness is also the objective of papers such as Arnoud W. A Booth Stuart I. Greenbaum and Anjan V. Thakor (1993), Luca Anderlini and Leonardo Felli (1999), Battigalli and Maggi (2002), and Steven Shavell (2006), while a recent paper by Benjamin E. Hermalin (2008) examines the efficiency of endogenous contract incompleteness. See also Hermalin, Avery W. Katz and Richard Craswell (2007) for a comprehensive review of the law and economics of contracts.

and Surajeet Chakravarty and MacLeod (2009). But while they analyze models where ex ante contract specifications affect the parties' actions ex post (such as renegotiations), we analyze a model where ex ante contract specifications affect the court's ability to verify whether actions are in line with the intents of the contract. We thus take the view that contracting parties have court protection rather than ex post adaptation in mind when *formulating* explicit contracts.

The remainder of the paper is organized as follows: Section I presents the model and characterizes optimal contracts. In sections II and III we analyze how the relational contract equilibrium varies with the discount factor and the verification technology, respectively. Section IV concludes. Proofs not explicitly stated in the text are contained in an appendix.

I. The Model

We consider a relationship between a risk neutral principal and a risk neutral agent, where the principal offers a contract (s, q) to the agent, saying that the agent is paid s if he delivers a good with a quality that the principal values at q . The cost of producing quality q is $C(q)$, where $C'(q) > 0$, $C''(q) > 0$, $C(0) = 0$. Reservation payoffs are zero, for convenience.

We follow the standard assumption in incomplete contract theory saying that if the variables in a contract are non-verifiable, the contract is not enforceable by a court of law. But in contrast to existing literature, we assume there is a probability $v \in [0, 1)$ that the contracted quality can be verified, and hence that the contract is enforced.⁴ Verifying quality implies verifying whether or not - and to what extent - there has been a breach, i.e., verifying q and q' , where q' denotes the agent's realized quality.

The probability v is assumed to depend on the level of contracting: the more the parties invest in specifying contract terms, the higher is the probability that the court can verify whether the realized quality deviates from the one described in

⁴By not allowing for $v = 1$, we assume that perfect verifiability is prohibitively costly. This is in line with the standard assumption ($v = 0$) in the relational contract literature.

the contract. We let $K(v)$ be the cost that must be incurred to achieve verifiability level v , and we interpret K as the costs associated with writing explicit contracts specifying the quality of the good.⁵

To keep the model simple, we assume that values accrue directly to the principal in the process of production, so that the agent cannot hold up values ex post.⁶ The model then best describes situations where the agent provides ongoing services like consulting, maintenance, IT services, HR services, administrative services etc.⁷ Service contracts typically focus on the quality of the performance, and are often labeled "service level agreements" in the industry. For instance, a service level agreement for IT services will include performance measures for the service provider's availability, reliability and the quality of the administrative support. The costs associated with writing these contracts are typically due to the time and effort spent on defining operational metrics for measuring service levels so that the actual performance (or score) on the relevant metrics can later be verified by a court of law.⁸

We analyze a repeated relationship where the following stage game (Γ) is played each period:

1. The principal makes an investment $K(v)$ in writing a contract with verifiability level v , where v is common knowledge, and offers a contract (s, q) to the agent. If the agent rejects the offer, the game ends. If he accepts, the game continues to stage 2.

⁵We assume throughout that contracting costs are independent of q ($K_q = 0$). One can show that our comparative statics results are valid as long as $K_{qv} = 0$, and are not altered qualitatively even if $K_{qv} \neq 0$.

⁶It can be shown that various extensions of the model, where values do not accrue directly to the principal, and where we allow for ex post bargaining and outside options, do not alter our main results qualitatively.

⁷The model is compatible with production of physical goods as long as the principal owns the good once it is produced. In such cases the agent is typically an integrated supplier, or simply an employee. When the agent is a service provider, however, he may well be a non-integrated supplier, since services typically accrue directly to the buyer in the process of production.

⁸See John K. Halvey and Barbara Murphy Melby (1996) for a comprehensive methodological and practical approach to contracting on IT services.

2. The agent provides quality q' .
3. The principal observes q' and chooses payment s' .
4. The parties choose whether or not to go to court. If at least one party goes to court and the court verifies quality, it rules according to a breach remedy that is ex ante common knowledge. If no party goes to court, or if the court does not verify quality, the agent and the principal obtain payoffs $s' - C(q')$ and $q' - s' - K(v)$, respectively.⁹

A spot contract is taken to be a subgame perfect equilibrium (SPE) of this stage game. We deduce the optimal spot contract below applying two standard breach remedies, namely expectation damages and reliance damages. We then move on to analyze the infinite repetition of the stage game Γ . A relational contract between the parties describes an SPE of this infinitely repeated game.

In long-term relationships, ongoing investments in contract modifications are common. But contract modifications do not necessarily imply that equilibrium v is changed. In fact, we consider stationary contracts where the same equilibrium (v, q) is realized every period. Such a case arises when e.g., new technological developments or market demands imply that the content of q changes, but the costs required to produce the object of value q , or the verification level v , do not change. Then contract modifications are required even if costs $C(q)$ and $K(v)$ are unaffected.¹⁰

For simplicity, we assume that it is costless to go to court. As we shall see, the parties end up in court in the static spot contract equilibrium, but not in the repeated relational contract equilibrium. Litigation costs can thus affect contract

⁹The contract is assumed to be silent about the consequences of deviations from the specified (s, q) . This captures the institutional feature that breach remedies are decided by the courts, not by the parties themselves. Given Uniform Commercial Code (UCC) §2-718 (1987), and RESTATEMENT (SECOND) OF CONTRACTS §356 which prevents courts from enforcing terms stipulating damages that exceed the actual harm, no party-designed damage rule can do better than the standard breach remedies considered in this paper.

¹⁰It can be shown that whether such costs are incurred every period, or just prior to the first stage game, is not crucial for the results we obtain.

surpluses in our model, but can be seen not to qualitatively affect our results.¹¹

A. The spot contract

Here we characterize the spot contract, which is assumed to be a subgame perfect equilibrium of the stage game Γ outlined above. We analyze the game with expectation damages (ED) and reliance damages (RD), respectively, as breach remedies.¹²

Expectation damages: Our interpretation of ED in the present setting is as follows. If the court verifies insufficient quality or payments ($q' < q$ or $s' < s$), it rules that any breaching party is to comply with that party's part of the contract (s, q) . If the court verifies that a party has more than fulfilled its contract terms ($q' \geq q$ or $s' \geq s$), it takes no action towards that party. The court's ruling implies payoffs $\hat{q} - \hat{s} - K(v)$ for the principal, and $\hat{s} - C(\hat{q})$ for the agent, where $\hat{q} = \max(q, q')$ and $\hat{s} = \max(s, s')$.

Without further qualifications, this interpretation would imply that the parties are enforced to comply with the contract (s, q) in all circumstances where the court verifies $q' < q$ or $s' < s$. This may not be realistic in all cases, due to limited liability and other institutional and legal constraints. Moreover, such a strict enforcement opens up another possibility; namely that the parties can write a formal contract that they never intend to fulfill, but just to have as a punishment should anybody deviate from the intended (equilibrium) actions. For these reasons, and in line with institutional realities, we therefore allow the parties to renegotiate payments after verification. Specifically, we assume that the principal after verification may propose a modified payment to the agent for the delivered quality q' , which the agent may accept or refuse. If refused, the parties must comply with the court's ruling.

¹¹One can show that litigation costs reduce the long-term incentives to deviate from the relational contract due to a lower spot surplus, but may increase the short-term incentives to deviate by increasing the costs of taking a contract breacher to court.

¹²In our model there is no uncertainty regarding the value of the transaction, and hence expectation damages is equivalent to another common breach remedy, namely 'specific performance' (SP), in which the breacher is required to perform what was contracted upon. SP and ED typically differ if there is uncertainty regarding costs, for instance if the true cost function is revealed ex post contract signing, but ex ante complete performance.

By backwards induction we start with stage 4, where the players simultaneously and independently choose whether to accept (q', s') or to go to court.¹³ If at least one player does not accept, but rather goes to court, the payoffs are given by the procedures defined above. We assume that each player chooses his/her weakly dominant action, and that he/she does not go to court if the two actions are payoff equivalent. It seems intuitively reasonable (and we verify in the appendix) that the agent will never supply $q' > q$ and that the principal will never pay $s' > s$ in this game. One then sees that court is avoided in stage 4 if and only if both players have adhered to the contract. But whether the agent has adhered or not, the principal's optimal response in stage 3 is then to deviate and offer $s' = 0$, essentially because her expected outlay in court is $vs < s$.

Given the principal's payment response in stage 3, the agent will clearly supply minimal quality ($q' = 0$) in stage 2. The case will then end in court and yield expected payoff $v(s - C(q))$ to the agent. He is thus willing to accept the contract if $s \geq C(q)$. The principal's highest continuation payoff is thus $v(q - C(q)) - K(v)$, and she will then in stage 1 choose q and v to maximize this payoff. This leads to the following result.

Proposition 1 *Under expectation damages, the equilibrium spot contract specifies first-best quality ($q = q^F$) and payments $s = C(q^F)$. In equilibrium both parties deviate from the contract, supplying minimal quality ($q' = 0$) and offering minimal payments ($s' = 0$), respectively, and the case ends in court. The equilibrium investment $K(v)$ and the associated value (U_1) for the principal are given by $\max_v [v(q^F - C(q^F)) - K(v)] = U_1$, provided $U_1 > 0$. If $U_1 \leq 0$, no contract can yield a positive surplus.*

We see that the equilibrium contract investment yields $v \in (0, 1)$ if $K'(0) < q^F - C(q^F) < K(1)$, and if any fixed cost $K(0) \geq 0$ is small enough to make the associated value U_1 positive.

¹³We treat stage 4 as a simultaneous move game, but this is not important for the results we obtain.

Reliance damages: Consider now reliance damages (RD), which in contrast to expectation damages do not leave the victim equally well off as under contract performance. Instead, the court instructs the parties to "leave the table as it is", but ensure that the victim of a breach is reimbursed the necessary preparation costs that was made in reliance on contract performance. We interpret this as follows: First, if the court verifies $q' < q$, the agent must award damages to the principal so that the principal is no worse off than before the contract (s, q) was signed. This implies that the principal is compensated for reliance costs, taken here to mean the contracting costs $K(v)$ incurred in preparing the contract.¹⁴ The principal and the agent then get payoffs q' and $-C(q') - K(v)$, respectively. Next, if the court verifies $q' \geq q$ and $s' < s$, it holds the principal as the breacher, and then awards damages to the agent so that he is equally well off as if the contract (s, q) was never signed. The principal must thus compensate the agent for costs $C(q)$ and hence gets $q' - C(q) - K(v)$, while the agent gets $C(q) - C(q')$. Finally, if the court verifies $q' \geq q$ and $s' \geq s$, it is assumed to take no action.

Note that when the court applies RD as breach remedy, it never induces a change of output, so the total surplus remains unchanged. The parties thus play a zero-sum game, and the agent's equilibrium payoff cannot be larger than the payoff resulting from the principal choosing $s' = 0$. (In fact, this choice is optimal for the principal.) If $q' \geq q$ the agent is then entitled to reliance damages, hence he will go to court and get payoff $vC(q) - C(q') < 0$ (for $v < 1$). If $q' < q$ the principal will go to court to obtain damage payments, and the agent's payoff will then be $-C(q') - vK(v) < 0$. No contract can thus make the agent produce $q' > 0$, and since the court does not influence output under RD, we have:

Proposition 2 *Under reliance damages, no spot contract can generate a positive surplus.*

¹⁴Other interpretations are possible, for instance that reliance costs are taken to mean contracting costs in excess of any realized surplus ($K(v) - (q' - C(q'))$). This does not alter the conclusion.

B. Relational contracting

The analysis of the spot contracting game showed that when there is a positive probability that the court cannot verify the contract, then for a positive surplus to be created under standard breach remedies the case must end up in court. But of course, not all contracting relationships end up in court. One important reason is that the parties may incur reputational costs if they renege on their contracts. This is the basis for relational contracts, where renegeing leads to costs in terms of lost surplus in the future.

A self-enforcing relational contract is a subgame perfect equilibrium of the infinitely repeated game where the stage game Γ is played every period.¹⁵ We consider stationary trigger strategies, where the parties revert to the equilibrium of the stage game forever if a party deviated from the contract in any history of play. Let σ_{sa} and σ_{sp} denote the equilibrium strategies of the stage game for the agent and the principal, respectively, and let (v, s, q) denote the per-period set of actions to be played in the SPE of the repeated game.

The trigger strategy for the principal (σ_{rp}) specifies play in accordance with (v, s, q) if there has been no deviations from (v, s, q) in the past (in earlier periods or within the period), and reversion to play in accordance with the spot contract (strategy σ_{sp}) otherwise.¹⁶ The agent's trigger strategy (σ_{ra}) is similar; it specifies play in accordance with (v, s, q) if there has been no deviations in the past, and reversion to the spot contract (strategy σ_{sa}) otherwise.

¹⁵Taking a simpler approach, one could instead consider exogenous reputational costs in the spot game. If the principal incurs a monetary cost R if she reneges on the spot contract, she will honor the contract if R is sufficiently large to balance her temptation to deviate; $R + vs \geq s$, and thus $R \geq (1 - v)C(q)$ in equilibrium. But since reputational costs are typically determined by the loss of future surplus, the repeated game approach appears more adequate for analyzing how such costs affect contracting outcomes.

¹⁶Specifically: in period 1, play (v, s, q) in stage 1; i.e., invest $K(v)$ and offer contract (s, q) . In stage 3 offer $s' = s$ if the agent supplied $q' = q$ in stage 2 and (v, s, q) was played in stage 1; play according to σ_{sp} in stages 3 and 4 if not. In stage 4, do not go to court if (v, s, q) was adhered to in stages 1-3, follow σ_{sp} otherwise. Then, in period $t > 1$, play as in period 1 if (v, s, q) was played in all preceding periods; play σ_{sp} if not.

Consider now the strategies $(\sigma_{rp}, \sigma_{ra})$. Let u denote the surplus in the spot contract; so $u = U_1$ under ED and $u = 0$ under RD. Recall that the agent received a payoff of zero in both cases. It is then straightforward to check that the agent cannot gain by a unilateral deviation from the relational contract (from strategy σ_{ra}) if $s \geq C(q)$. This condition is also necessary for participation by the agent. For the contract to be sustainable (the trigger strategies to constitute an SPE) the principal must not be tempted to deviate from paying s when the contract has been adhered to previously. This implies:

$$(1) \quad \frac{1}{1-\delta} [q - s - K(v)] \geq q - K(v) - vd + \frac{\delta}{1-\delta} u,$$

where $d = s$ under ED, and $d = C(q)$ under RD. Condition (1) says that the principal will, after observing $q' = q$, honor the contract if the net present value from honoring is greater than the net present value from reneging. A deviation from s triggers reversion to the spot strategies, according to which there is court involvement when $q' = q$ and $s' < s$. The optimal deviation is then $s' = 0$, and this yields the payoff given by the RHS of (1).

It is possible to find an s satisfying $s \geq C(q)$ and (1) if and only if

$$(2) \quad q - C(q) - K(v) - \frac{1}{\delta}(1-\delta)(1-v)C(q) \geq u$$

An efficient contract maximizes per period total surplus $q - C(q) - K(v)$ subject to (2). The constraint implies $q - C(q) - K(v) \geq u$, and the contract will thus satisfy the participation constraint for the principal. When a relational contract equilibrium exists, it will yield a (weakly) higher surplus than the spot contract.

We see that the constraint (2) is weakest under RD, since then $u = 0$. Hence, while ED is a better breach remedy than RD under spot contracting, RD is better than ED under relational contracting. A judicial lesson from our model is thus that breach remedies that are optimal under one-shot contracting, may be suboptimal under relational contracting. In fact, the worst breach remedy under spot contracting has the advantage of being the maximum long-term punishment from breaking the relational contract. The model thus exemplifies a more general insight emphasized by legal scholars, namely that one cannot understand legal rules without understanding the norms of social enforcement (see e.g., Robert E. Scott, 1990).

Interestingly, RD is quite commonly used in the kind of incomplete contracting environment considered here. But while the standard argument for RD is related to the difficulty of assessing expectation damages when contracts are incomplete, our argument is based on RD's superior support for the relational contract.¹⁷ Schwartz (1992) ascertains that courts often show a more "reticent judicial attitude (...) in relational contexts". RD is clearly a more reticent and less "gap-filling" remedy than ED, and while our formal argument for RD is new, we believe that it can elucidate the somewhat surprising judicial reluctance to apply ED in many contractual settings.¹⁸

Consider now the optimal relational contract for a given breach remedy (ED or RD). Note that there is $\delta^F < 1$ such that the first-best allocation $q = q^F, v = 0$ is implementable (satisfies the constraint (2)) for $\delta > \delta^F$. It is straightforward to show that for a range of discount factors in $(0, \delta^F)$ the efficient contract will entail an interior solution ($0 < v < 1, 0 < q < q^F$) if the contract cost function $K(v)$ has sufficiently small marginal and absolute (fixed) costs at $v = 0$. The interior solution implies that writing a formal contract on q (i.e., making contract investments so that $v > 0$) is valuable even if the contract will be self-enforcing in equilibrium. Moreover, it implies that the contracted and realized quality level can be lower in the relational contract equilibrium than in the spot contract equilibrium, even if the surplus is higher in the relational contract.¹⁹ In the next sections we demonstrate that this holds in a marginal sense, by showing that better conditions for relational contracting may reduce equilibrium quality.

¹⁷While RD is typically advocated when uncertainty makes ED and specific performance (SP) differ, we find RD to be optimal in a setting where ED and SP coincide. In our model, the only uncertainty pertains to whether the court is able to verify the contract, and this calls for relational contracting. The model thus suggests that a difference between ED and SP is not necessary for RD to be optimal.

¹⁸An alternative argument is provided by Yeon-Koo Che and Tai-Yeong Chung (1999). They show that RD can be optimal when parties make cooperative investments, and argue that this can explain the frequent use of RD in public procurement and some industrial buyer-supplier relationships.

¹⁹Under spot contracting with ED as breach remedy, the equilibrium contract specifies first-best quality.

II. Trust and contractual incompleteness

A common feature of the self-enforcing relational contracts studied in the literature is that equilibrium investments are positively related to the parties' trust in the relationship, i.e. their discount factors.²⁰ This should in our model imply that a higher discount factor induces higher quality. But as recently emphasized by MacLeod (2007), trust or reputation should not be based upon quality per se, but upon whether or not a party has breached an agreement. Indeed, as we will now demonstrate, there can be a negative relationship between quality and the level of trust (represented by the discount factor δ).

From (2) we see that if δ increases, the constraint is relaxed, so the social surplus must increase. This is illustrated in Figure 1.²¹ The thin curves are indifference curves for social surplus in q, v - space, with lower curves representing higher surplus. The first-best allocation ($v = 0, q = q^F$) is represented by point q^F on the horizontal axis. The two bold curves represent the constraint, for two levels of δ . For each curve, the admissible q, v -values are in the northwest region (and bounded by $v = 1$). The constraint curve shifts down as δ increases.

If the verification level v is held fixed, a higher δ allows for a higher implementable quality q . And if q is held fixed, a higher δ allows the principal to save on contract investments, thus reducing v . But both v and q will optimally change with δ . In general the higher δ will affect the slope of the constraint curve. If the slope increases, the rate of substitution between v and q increases, so it becomes more costly to substitute quality for lower verification investment. This price change will induce a substitution effect that in isolation will lead to *reduced quality*. But there

²⁰The repeated game approach formalizes an economic concept of trust and trustworthiness, see Harvey S. James Jr. (1995). In our setting the definition of trust is not important, it is mostly a matter of finding a suitable interpretation for the rather technical term "discount factor". We might as well see the discount factor as a proxy for the level of "mutual dependence".

²¹The figure is generated with $C(q) = \frac{1}{2}q^2$, $K(v) = av$, $u = 0$; $\delta = \frac{1}{4}$ and $\delta = \frac{1}{3}$ for the two constraints, and $a = \frac{1}{8}$. These functions are simple and illustrate the problem well, but $K(v)$ should strictly speaking be modified for large v (say for $v > .9$) so as to make $v = 1$ prohibitively costly.

may also be an 'income effect' working in the opposite direction on quality. These considerations indicate that the equilibrium response to a higher δ may be either a higher or a lower level of quality.

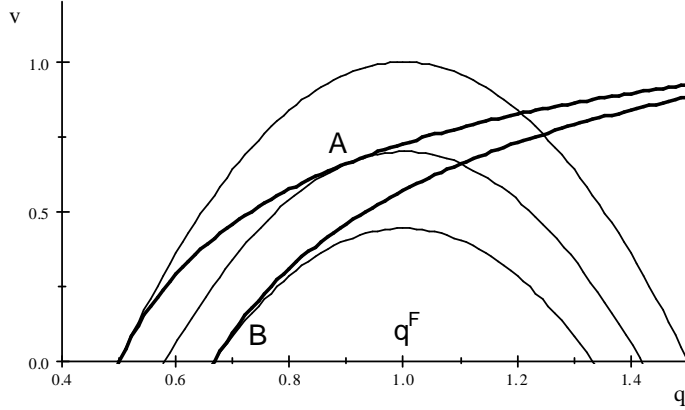


Figure 1

For the case illustrated in Figure 1, both q and v decrease in response to the higher δ . In fact, in this case the equilibrium shifts from one with positive investment ($v > 0$) and a relatively high quality q (point A), to one with no investment and a considerably lower quality (point B). We see that keeping q fixed at the level associated with point A, the feasible reduction in v will here lead to a point where the (new) constraint curve is steeper, and hence where a reduction of quality is attractive.²² Such a process leads in this case to point B. The gain in surplus is thus realized by totally eliminating costly contracting costs, and relying instead solely on the relational contract, which can only sustain a relatively low level of quality.²³

By a slight reparametrization of the model, the shift from positive to zero contract investments can be interpreted as a shift from a sophisticated to a standard form contract.²⁴ For suppose there is available a standard contract that yields a positive verification level $\underline{v} > 0$, and that incremental investments to increase the

²²More precisely, the slope has increased relative to the slope of the indifference curve.

²³Although relational contracting is a response to contract incompleteness, the example also illustrates that relational contracting can cause contracts to be more incomplete. Jean Tirole (2009) shows that such reverse causality also can arise from limited cognition.

²⁴Many industries have developed contract standards that parties can use to save on contracting costs, see e.g., the form construction contracts published by the American Institute of Architects, which are widely used in the U.S industry and cover all aspects of the construction process. See also Chakravarty and MacLeod (2009) for an interesting analysis of these standard contracts.

level beyond \underline{v} can be made at costs $K(v - \underline{v})$. Then under similar conditions to those illustrated in Figure 1, the higher δ would lead to a shift from positive to zero investments, but now representing a shift in verification levels from $v > \underline{v}$ to $v = \underline{v}$. Hence, better conditions for relational contracting in terms of higher δ , may lead the parties to rely on the less expensive standard form contract, at the cost of sacrificing some quality.

Analyzing marginal variations in δ , we find that the elasticity of the marginal contract cost function $K'(v)$ is important for the results. Note that $(1 - v)K''(v)/K'(v)$ measures the relative increase in marginal costs per percentage reduction in the probability of non-verification $(1 - v)$, and is hence a measure of the elasticity of this function. We find the following:

Proposition 3 *Given interior solutions, quality will decrease with a higher level of trust (higher δ) if and only if marginal contracting costs are inelastic, in the sense that $(1 - v)K''(v)/K'(v) < 1$.*

For quality q to decrease with higher δ , the equilibrium v must decrease. The elasticity of $K'(v)$ is important in this respect, since the response in v to a change in δ is larger, the less elastic is $K'(v)$. When $K'(v)$ is inelastic, a higher δ makes it optimal to reduce v so much that the equilibrium quality decreases.²⁵ Hence, to obtain the standard result that higher δ *increases* quality one actually needs *elastic* marginal contract costs.

The proposition demonstrates that properties of the contract cost function can be essential for understanding relational contracts. Contracting should be regarded as part of the technology of exchange, and changes in this technology, such as more standardization of contracts or better legal institutions, may have interesting implications, as we shall discuss in the final section.

²⁵In a one-shot model with monetary reputational cost R (see footnote 15), q is decreasing in R under the same elasticity condition.

III. Verification technology

The necessary cost to achieve a given level of legal enforcement may differ between countries, industries and types of transactions. The complexity of the transactions, the strength of enforcement institutions and the practice of legal courts are factors that determine the verification technology. We now analyze how improvements in this technology affect the equilibrium levels of q and v . Our main point is not to address and interpret all feasible parameter changes, but rather to point out the existence and plausibility of the most interesting cases. In particular, we will show that improved verification technology does not necessarily imply that verifiability v and quality q increase in equilibrium. For expositional reasons we consider here only the case of RD being the breach remedy.

Consider then the effect of changes in verification technology, represented by a shift in the contract cost function. For a function $K(v, \kappa)$ with $K_\kappa \geq 0$ we thus examine how the equilibrium quality $q(\kappa)$ and the verification level $v(\kappa)$ vary with κ . Consider first a reduction of fixed costs (keeping marginal costs unaffected, i.e., $K'_\kappa \equiv \frac{\partial^2 K}{\partial \kappa \partial v} = 0$). The cost reduction will relax the constraint, and the lower fixed cost will geometrically shift the constraint curve vertically downwards. This is similar to the effect of an increase of the discount factor discussed in the previous section, and hence we should expect similar comparative statics result.²⁶ We obtain the following:

Proposition 4 *A reduction of fixed contracting costs leads to lower quality and verification probability in equilibrium if marginal contracting costs are inelastic, in the sense that $(1 - v)K''/K' < 1$.*

²⁶If ED is breach remedy, a cost reduction will also increase the spot surplus. If the reduction is equal for all v -levels, it will then not affect the relational constraint and hence not the equilibrium solution. Thus a cost change can have different implications, depending on the breach remedy. But if the change occurs only locally, in the sense that the cost function is affected only for v -levels close to the equilibrium level in the relational contract (and not affected at the equilibrium level in the ED spot contract), the cost change will have qualitatively similar implications under both remedies.

The result that improved verification technology can lead to lower verification probability supports the view that the ability of a country's court system cannot be measured from the predictability of the courts. In our model the verification technology captures essential quality aspects of the court; the technology will in particular be more favorable the higher the court's ability to verify the true intent of a contract. And we can interpret the verification probability v as a proxy for the court's predictability. Since higher court ability can give lower verifiability in equilibrium, higher court ability can thus imply less predictability in equilibrium. We can say that the gain from a 'high ability' court system may be realized through a higher degree of relational contracting rather than a higher degree of explicit contracting.

Consider next a cost change that affects marginal but not fixed costs. Let (q^*, v^*) be some equilibrium, and suppose marginal verification costs increase locally in the sense that $K'_\kappa(v^*, \kappa) > 0$ and $K_\kappa(v^*, \kappa) = 0$ (so that total verification costs are unchanged). We then obtain the following.

Proposition 5 *A local cost variation that increases marginal but not total contracting costs ($K'_\kappa > 0, K_\kappa = 0$) leads to lower quality and verification probability in equilibrium.*

The common law system is assumed to be more willing to enforce specific contract terms than civil law, which to a larger extent set party-designed contract terms aside if it conflicts with the civil codes. This indicates that the marginal effect on v of investing in detailed contracts is higher in common law. On the other hand the civil codes assure that a minimum level of verifiability can be achieved at relatively low costs. This suggests that the function $K(v)$ will tend to be flatter, but have a higher intercept in common law compared to a civil law system. It further suggests that we may interpret a marginal change where $K'_\kappa(v^*, \kappa) > 0$ and $K_\kappa(v^*, \kappa) = 0$ as a marginal move from common to civil law practice. Proposition 5 shows that such a move should imply a lower v in equilibrium. In some aspects, this fits with the empirical court study made by Simeon Djankov, Rafael La Porta, Florencio Lopez-De-Silanes and Andrei Shleifer (2003), who find less fairness and consistency in civil

law than in common law courts. However, as we have underscored in this paper, this alone should not be interpreted as evidence that civil law is less efficient than common law systems, since equilibrium v is not a good measure for court ability.

As a final application of the results in this section, consider how changes in standard contracts may affect equilibrium contract investments. In a setting with a standard contract yielding verification probability \underline{v} and incremental contract costs $K(v - \underline{v})$, an improved such contract (higher \underline{v}) will generally reduce both total and marginal contract costs. But if marginal contract costs are perfectly inelastic ($K'' = 0$), only total costs will be reduced, and then we see from Proposition 4 that the equilibrium quality and verification probability will be reduced as a consequence of the improved standard. This will hold also if $K'()$ is less than perfectly inelastic. If marginal contract costs are sufficiently inelastic, better contract standards will thus lead to smaller contract investments and lower quality supplied in equilibrium.

IV. Concluding remarks

By endogenizing verifiability, our model can illuminate a relationship between classic references in the literature on transaction costs. One interpretation of the model is that the explicit contract costs (K) correspond to Coase's (1937) concept of transactions costs, while the efficiency-loss of not being able to implement first-best quality corresponds to the type of transaction costs discussed by Klein, Crawford and Alchian (1978) and Oliver E. Williamson (1985), and the property rights literature, starting with Sanford J. Grossman and Oliver Hart (1986). While Coase focuses on the costs of "negotiating and concluding a separate contract for each exchange transaction..." Williamson and Klein, Crawford and Alchian focus on problems of opportunism and underinvestment. By introducing an endogenous probability of legal contract enforcement, we get hold of the substitutability between these types of transactions costs. But perhaps more importantly, the model demonstrates that explicit contract costs are not transaction costs in the sense of waste. Contracting is an investment, and contract costs must be considered as an endogenous variable determined in equilibrium.

Scant attention has been paid to contract enforcement in the incomplete contract literature. In models of relational contracts, enforcement *is* the central issue, but probabilities of *legal* enforcement is excluded. By introducing endogenous verifiability in a relational contract set-up, we show how legal institutions can play a role in trust-environments. Along these lines the model may serve as a tool for studying the effects of institutional differences in modes and possibilities of legal enforcement.

Our focus in this paper has been to show how trust - established through repeated interaction - and legal courts may induce contractual incompleteness. That is, contracting parties can realize the surplus from being governed by these enforcement devices by lowering the expenditure in contracting. This can explain why business relationships that are based on trust may be troubled with relationship specific underinvestments, and why contracts may be so loose in countries where the legal system is well developed.

The contracting environment we consider is simple, and could be extended in various ways, including the introduction of asymmetric information and agent hold-up. A richer framework may deepen our understanding of contract choice in a variety of situations where contracting is costly, and will enable us to make further comparisons of different legal breach remedies and optimal court behavior in models of incomplete contracts.

APPENDIX

PROOF OF PROPOSITION 1:

It remains to show that $q' > q$ or $s' > s$ cannot be optimal, and that the court is avoided in stage 4 iff $q' = q$ and $s' = s$. For any $s' \geq s$ the agent weakly prefers not going to court (since the court will not increase the payment but may force him to produce more). The principal will then not offer $s' > s$, since lowering the offer to $s' = s$ will not affect the agent's response, and it will increase the principal's payoff in both outcomes (court or not).

Given $s' \leq s$ in stage 3, the agent will, for any $q' \geq q$ weakly prefer going to court in stage 4, and strictly so if $s' < s$ (because the court will then, in case of verification, increase the payment, but will never require increased production). The principal then prefers to end up in court (by offering $s' = 0$) rather than avoiding it ($s' = s$), because the former reduces her expected payments without affecting production. For any $q' \geq q$ supplied in stage 2 the agent will thus end up in court, and obtain the payoff $v(s - C(q')) + (1 - v)(0 - C(q'))$. Supplying $q' > q$ can then not be optimal.

Consider stage 4 for a contract (s, q) . Let $S(q) = q - C(q)$ be the associated surplus. Note that if $q > q^F$ it is possible that supplying $q' < q$ yields $S(q') > S(q)$, i.e. a higher surplus than the surplus associated with the contracted quality q . If this is the case, and if the court becomes involved and verifies quality, the court's ruling (increase quality from q' to q) will lead to renegotiation. Instead of accepting the payoffs implied by the court's ruling ($q - s$ to the principal and $s - C(q)$ to the agent), the principal can propose a new payment t to the agent, which the agent will accept if $t - C(q') \geq s - C(q)$. The principal can in this way induce the agent to leave output at q' and capture the surplus gain $S(q') - S(q)$ for herself.

There is no scope for renegotiation if $S(q') \leq S(q)$. The principal's and the agent's payoffs after court verification and possible renegotiation are thus $q - s + \Delta(q', q)$ and $s - C(q)$, respectively, where $\Delta(q', q) = \max\{S(q') - S(q), 0\}$. The principal will then avoid the court action iff $q - s + \Delta(q', q) \leq q' - s'$, and the agent will avoid this action iff $s - C(q) \leq s' - C(q')$. This implies that court is avoided in stage 4 iff $\Delta(q', q) + q - q' \leq s - s' \leq C(q) - C(q')$. This condition will hold

iff $q' = q$ (because by definition $\Delta(q', q) + q - q' \geq C(q) - C(q')$) and thus $s' = s$. Hence court is avoided iff both parties have adhered to the contract.

PROOF OF PROPOSITION 3:

The optimization problem is of the form $\max_{q,v} f(q, v)$ s.t. $G(v, q, \delta) \geq 0$, where $f(q, v) = q - C(q) - K(v)$ and $G = f - H$, with $H(q, v, \delta) = \frac{1-\delta}{\delta} (1-v) C(q) + u$.

Let $L = f + \lambda G$ be the Lagrangean. Given sufficient second order conditions (SOC), standard comparative statics yield $q'(\delta) = \frac{1}{D} ([L_{vv}G_q - L_{qv}G_v] G_\delta + [L_{q\delta}G_v - L_{v\delta}G_q] G_v)$, where $D > 0$ is the determinant of the bordered Hessian of L (see below).

Note that from $L = f + \lambda G$, $G = f - H$ and the FOCs $f_k = -\lambda G_k$, $k = q, v$, we have

$$G_k L_{ij} = G_k f_{ij} + G_k \lambda G_{ij} = (f_k - H_k) f_{ij} - f_k (f_{ij} - H_{ij}) = f_k H_{ij} - H_k f_{ij}$$

Substituting this in the formula for $q'(\delta)$ yields

$$(A1) \quad \begin{aligned} q'(\delta)D &= [(f_q H_{vv} - H_q f_{vv}) - (f_v H_{qv} - H_v f_{qv})] G_\delta \\ &+ [(f_v H_{q\delta} - H_v f_{q\delta}) - (f_q H_{v\delta} - H_q f_{v\delta})] G_v \end{aligned}$$

Note that $H_{q\delta}/H_{v\delta} = H_q/H_v$, and that FOC and $G = f - H$ implies $f_q/f_v = G_q/G_v = H_q/H_v$. These relations imply $f_v H_{q\delta} - f_q H_{v\delta} = 0$. Substituting this in (A1) together with the partials of $f()$ and $H()$ then yields

$$q'(\delta)D = [0 + K'' H_q + K' H_{qv}] (-H_\delta) + 0 \cdot G_v = [(1-v)K'' - K'] H_{qv} H_\delta$$

where the last equality follows from $\frac{H_q}{H_{qv}} = -(1-v)$. Since $H_{qv} < 0$ and $H_\delta < 0$, this verifies that $q'(\delta)$ has the same sign as $(1-v)K'' - K'$, and hence the claim in the proposition, conditional on the SOC $D > 0$ being satisfied.

Computing D from the bordered Hessian of L yields $D = -L_{vv}G_q^2 + 2L_{qv}G_qG_v - L_{qq}G_v^2$. Substituting as above, and using the FOCs, one can verify that D has the same sign as $D_1 = (1-v)K''(1-C')/K' - 2(1-C') + CC''/(C')^2$. This is positive also for $(1-v)K''/K' < 1$ provided, say, $C()$ is sufficiently convex.

PROOF OF PROPOSITION 4 AND 5:

Applying (A1) to differentiation with respect to κ yields

$$q'(\kappa)D = [f_q H_{vv} - H_q f_{vv} - f_v H_{qv} + H_v f_{qv}] G_\kappa + [f_v H_{q\kappa} - H_v f_{q\kappa} - f_q H_{v\kappa} + H_q f_{v\kappa}] G_v$$

Substituting for the relevant partials, and using $H_q/H_{qv} = -(1 - v)$, we obtain $q'(\kappa)D = \{[-(1 - v)K_{vv} + K_v]K_\kappa - (1 - v)K_{v\kappa}G_v\}(-H_{qv})$. Since $H_{qv} < 0$ and since FOC implies $G_v = -\lambda f_v > 0$, this equation for $q'(\kappa)$ verifies the statements regarding $q(\kappa)$ in Proposition 4 (where $K_{v\kappa} \equiv K'_\kappa = 0$) and in Proposition 5 (where $K_\kappa = 0$ and $K_{v\kappa} > 0$). The stated properties of $v(\kappa)$ then follow from the constraint equation.

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