Implicit Contracting Close to Anonymity*

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Abstract

Implicit contracts enforced by repeated interaction or reputation both require stability in the economic environment that simply is not present in a large number of transactions that exhibit limited reliance on external enforcement. Although instability of the environment forces contractual arrangements that are closer to the anonymity of market exchange, this instability leaves open an important avenue for contractual enforcement. This paper presents one class of such environments and shows how a simple mechanism can give rise to Pareto-improving implicit contracting. The key assumption is that in one-period relationships benefits and costs can arise which are extremely asymmetric; minimal cost to one party can cause large increases in the value of the transaction to the other party. We provide several motivating examples, such as new product development, the relationship between the journal editor/researcher and the expansion of trade to new, potentially unknown, partners.

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1 Introduction

Contractual enforcement need not involve external parties such as courts or private arbitration.[1] Economists commonly argue that long term relationships as well as reputational concerns can internally enforce contractual duties.[2] However, repeated interaction and reputation both require the identity of the contracting parties to be stable over time. This stability contrasts starkly with the relative instability of identity in market transactions where identity only matters for the transaction at hand. In this paper, we revisit the enforcement mechanisms at the disposal of implicit contracts to show that implicit contracting can occur even when the identities of contracting parties approach the anonymity of market exchange. Focusing on this enforcement mechanism is important since implicit contracting is commonly criticized for precisely the same reason it is considered successful, that contracting parties become locked into transactions with a narrow pool of possible contracting partners.

More importantly, however, than merely addressing the theoretical basis of this criticism is the fact that the marketing and management literatures as well as the law and economics and organizational economics literatures have compiled a large number of contracting relationships that exhibit limited use of external enforcement while not quite satisfying the conditions for internal enforcement currently understood by the literature. For example, consider the development of a new product. Because the product is new, its producer may require the help of a developer with whom the producer is unfamiliar. In addition, the developer may not develop the specified product because the producer had trouble specifying the new product. It is also possible the developer shirked or the product was not feasible technically. These difficulties in monitoring mean that reputation can not credibly enforce the relationship. Furthermore, the value of the innovation is not certain limiting the role for repeated interaction (at least, ex ante). Nevertheless, new products are developed all the time through diverse organizational structures, such as within the firm, through entrepreneur/financier, and multi-firm cooperation.

One explanation the literature has offered for such observations invokes the role of norms of trust and reciprocity in enforcing implicit contracts. While this explanation potentially expands the pool of trading partners to the group or even societal level, these behavioral traits require assumptions that sit uneasy with traditional economic methodology. While we do not deny that behavioral norms, individual or cultural, play a role in supporting economic transactions, this pa-

[1] There is a continuum of enforcement mechanisms ranging from extreme internal enforcement, namely purely self-enforcing agreements to the opposite extreme of exclusive external enforcement, namely violence. In the middle, one finds important legal institutions such as courts. Economists have started to study enforcement mechanisms that are located at the extremes, below we discuss internal enforcement and see Hirshleifer [2001] on violence.

[2] Klein and Leffler [1981], Levin [2003], Bull [1987].

per suggests an alternative mechanism that shares a similar incentive structure to reputation and relational mechanisms but does not rely on the same set of assumptions about the economic environment. In this paper, we showcase this mechanism through local innovations in a spot market in which we do not rule in relational and reputation enforced contracting. The former type of enforcement mechanism is not ruled in by the fact that there is no presumption that contracting with the same party in the next period is superior to contracting with a randomly selected party. The latter is not ruled in by focusing on local innovations in which success or failure to perform can not credibly affect reputation.[3] We use the notion of instability to characterize the environment in which both of these features are present. Although instability of the environment forces contractual arrangements that are closer to the anonymity of market exchange by restricting the use of contractual solutions in general, this instability can improve the limited efficiency of static self-enforcing agreements relative to relational contractual enforcement. Others have argued that instability may hinder the emergence of contractual obstacles such as hold-up (Klein [1996]). We argue that the asymmetric information that commonly arises in markets provides an indirect avenue for enforcing implicit agreements.

More concretely, consider a recent contract between the Warner-Lambert pharmaceutical company (P) and Ligand Technologies, a biotech firm (A).[4] P hires A to develop a drug to subsequently put through clinical trials and seek approval from the FDA and eventually commercialize the drug. P has little expertise in research and development of the chemical compounds that produce the desired effects. A has little expertise in the FDA approval process and, upon approval, the marketing of the drug. There is scope for an alliance. However, this process is costly, highly uncertain and competitive. Moreover, the lack of expertise and the nature of scientific discovery (as well as marketing) limits the observability of either party's efforts. Consequently, the contract uses many ambiguous terms such as "good efforts" and grants generous termination rights to P.[5] Prima facie, it is difficult to understand how these contracts work from either a formal enforcement or relational enforcement perspective.

However, the two sides of innovation, developing the product and subsequently producing and marketing the product, give rise to an incentive structure with the flavor of an implicit contract. On one side, the effort level of the developer (A) will be hard to monitor, both because effort is unobservable and successful product development is uncertain. Moreover, the specialization of the developer in producing the local innovation points to the necessity of the developer's assistance

[3]By local innovations we mean innovations tracking small changes in preferences, or minor technological improvements in production which neither have the scale to replace past vintages nor carry much certainty about the value of the innovation.

[4]This contract can be found at http://contracts.onecle.com. The authors were made aware of such contract in Gilson et al. [2009].

[5]Obviously, we omit many details of the contracting relationship here. We will discuss this contract in more detail in section 3.

in bringing the product to the market. In the example above, A needs to assist P in the clinical trials as well as provide support in case after approval, there is an unexpected lawsuit. Thus, the developer has a role both ex ante and ex post which immediately suggests some capacity for internal enforcement. On the other side, the marketer (P) possesses superior knowledge of the value of the innovation. In most cases, the consumer demand for the innovation at the time of product development is uncertain; in fact, by the time the product is developed, the innovation may not be worth marketing at all. Other competitors may have developed similar drugs or medical science may have advanced new technologies. Thus, P may need to signal the value of the innovation with a bonus payment in order to create incentives for the developer to remain with the project.

The key assumption is that in one-period relationships benefits and costs can arise which are extremely asymmetric; minimal cost to one party can cause huge increases in the value of the transaction to the other party. Thus, the essential elements of our model are: 1) uncertainty – in our model, the principal (and the agent) do not know the value of the innovation, and this value can change from period to period; 2) asymmetric information – the principal may observe a signal about the value of the innovation; 3) non-observability – the agent's effort in producing the local innovation is not observable and hence not contractible; 4) asymmetric costs – the agent has minimal support costs without which the product can not be marketed; 5) primary institutional enforcement – the primary aspects of the contract are enforceable.

When external enforcement is difficult and long-term relationships are unlikely, parties can also rely on market forces such as reputation. Shapiro [1983], Klein and Leffler [1981] both explore the role of reputation in enforcing implicit contractual duties which are difficult to enforce by an outside party. However, reputation requires the existence of a market and a mechanism to distribute information about reputation. Reputation is likely to work particularly poorly in the examples we have in mind. For example, Masten and Kosová [2009] argue that reputation does not function well in enforcing post-sale service agreements (which correspond to the developer's agreement to provide support in our model). The very nature of the contracting problem, that effort and performance are unobservable makes it difficult for reputation to credibly enforce contractual terms.

The paper proceeds as follows: First, we discuss the related literature and offer some further motivation in subsections 1.1 and 1.2. Section 2 presents the model. Next, we offer a few motivating examples in section 3. We then compare our model with the incomplete contracts and implicit contracting paradigms in section 4. Section 5 presents comparative statics. Finally, we detail some future directions in section 7 and conclude in section 8.

1.1 Related Literature

To illustrate the need for studying alternative enforcement mechanisms, consider one of the most ubiquitous contracting problems studied, contractual hold-up.[6] Hold-up occurs because the contract requires the transfer of assets that have more value within the set of contracting parties than outside. If one were to simply focus on formal court enforcement or vertical integration, one might miss an important contractual solution as shown by MacLeod and Malcomson [1993] who discuss third-party solutions to the hold-up problem. Likewise, restricting attention to only courts and third-party enforcers may also miss important contractual solutions as Scott [2003] has demonstrated.

When the performance of contractual duties is difficult to verify by a third party, we see contractual solutions that substitute for formal enforcement.[7] Baker et al. [1994], MacLeod [2003], Levin [2003] have studied how the optimal contract is structured in various contracting environments. Each of these studies requires that the parties to a contract have the possibility and the desire to interact in the future. Indeed the threat of terminating the relationship enforces present contractual duties. In section 3, we discuss a few examples of common implicit contracting environments that question the realism of this assumption. Of course, there are many environments when this logic applies, particularly in the development context. As Kranton [1996] has shown, reciprocal exchange (in-kind exchange not governed by third party enforcement) can persist even though a more efficient system of market exchange exists. Parties who exchange repeatedly choose to remain in the long-term gift exchange world because anonymous markets are too thin. In other words, incorporating alternative enforcement mechanisms into the analysis can significantly change which contracts appear and how they are enforced. In this paper, we are less interested in the trade-off between types of exchange and more interested in a mechanism that would support cooperative exchange in the one-period context. However, there is an important point to illustrate here: whereas long-term certainty provides the incentives for gift exchange in Kranton [1996], in this paper, it is precisely the potential for resolving the *short-term uncertainty* that enforces informal exchange.

This paper represents a merging of the incomplete contracts and implicit contracting literatures as described by Bolton and Dewatripont [2005]. On the one hand, we borrow the methodological approach of the incomplete contracting literature by assuming conditions that require contractual incompleteness, and, on the other hand, we focus on incentives as in the implicit contracting literature. As such, in section 4 we discuss the no contract and relational contract benchmarks based on Che and Hausch [1999] and Baker et al. [2002], respectively, in comparison to our model.

[6] Dixit [2004] provides a nice summary of the state of the literature on alternative enforcement mechanisms. For a more law and economics approach, see Hadfield [2004].

[7] Poppo and Zenger [2002] argue and demonstrate empirically that these relational mechanisms complement formal enforcement.

Rajan and Zingales [1998] also straddle the incomplete and implicit contracting literatures, but remain focused on the organizational form of the firm. In terms of Rajan and Zingales [1998], the agent in our model receives access shares to the idea behind the innovation, and this power does not necessarily show its face since the agent possesses inferior information. In a related paper, Motta and Rønde [2002] also start from Baker et al. [2002] to explain why a principal would honor informal bonus payments in both the static and repeated context. The answer they offer depends upon the relative value of the principal's and agent's contribution to the value of the project. If the agent's contribution is considerable, then the principal will pay the bonus to discourage the agent from leaving for a competitor with enough knowledge to develop a similar technology for the competitor. Akhmedov and Suvorov [2007] also stress the importance of a competitor in ensuring the payment of a noncontractible bonus. In their setting, the principal does not know the outside offers an agent might have access to, and this uncertainty drives up the payment given to the agent for specific investments. In contrast, our model concentrates on the value of the project to the principal. The principal has an incentive to pay the bonus since if no bonus is paid the agent will believe that the principal attaches little value to the project. Hence, the agent sees little reason to continue offering support for the project. In addition, our model comes closer to the anonymity of market exchange since an agent's competitors is not relevant.

The literature on the economics of innovation is also clearly relevant. Beckman et al. [2004] show empirically that firms are more likely to establish strategic alliances with new partners when faced with firm specific uncertainty than when faced with market wide uncertainty. Since these alliances may be governed by implicit contracts this finding reinforces the notion that implicit contracts can broaden the pool of contracting partners. Moreover, one justification for working with new partners is to increase information flows, the exact feature of our mechanism. In this light, our model provides a complementary explanation to Holmström [1989] for why small firms innovate more than large firms. Our model shows one possible pathway for implicit contracts to support large firms' desire to contract out innovation (given the large agency costs associated with innovation), further reducing the value of innovating inside the firm.

One working example we have offered is the collaborative research alliances between biotech firms and pharmaceutical companies. Robinson and Stuart [2007] argue that many terms in formal contracts are not observable by the court and sometimes not observable by contractual counterparts. Nevertheless, contracts do contain explicit terms that give protection to either party. They analyze the characteristics of such contracts such as complexity and termination severity. They argue that relational mechanisms explain the data better than standard static contract theory. Yet the data do not perfectly conform to the predictions of the relational story either. For example, the relational mechanisms they consider are insignificantly related with the

severity of contract termination.[8] However, a variable that is strongly positively related to the severity of termination is whether or not the contract is in the product development stage, a finding that is consistent with our notion of implicit contracting. An important component with the R&D alliances is the issue of multi-tasking whereby noncontractibility of the research leaves open the door for the researching firm to act opportunistically after the financing firm funds the project. Lerner and Malmendier [forthcoming] show how the assignment of control rights can limit this opportunistic behavior. The financing firm can terminate the relationship early but the control over what had been researched stays with the researching firm. Lerner and Malmendier [forthcoming] argue that termination and broad licensing rights function to limit multi-tasking by preventing the financing firm from opportunistically terminating the relationship while giving incentives for the research firm to work on the specified project. In contrast, our model sees termination as an integral part of the signaling mechanism that gives incentives for the research firm to exert effort.

Another relevant strand of the literature concerns the empirical observation, put forward as early as Holmström and Roberts [1998] that vertical integration often does not occur when we might expect it to, either from the transaction costs perspective (Williamson [2001]) or the property rights perspective (Grossman and Hart [1986]). Relational contracting is one of the solutions to this puzzle. Similarly, our model can also contribute to understanding this puzzle since the scope of contractual solutions widens. Furthermore, our model is not necessarily subject to the growing empirical observations that do not fit relational stories that well. In particular, Gilson et al. [2009] and Jennejohn [2008] argue that parties use formal contracts to not only align incentives but also to identify what particular interests they might share. Our paper adds to this literature by showing explicitly how learning about common interests reduces the scope for opportunism.

1.2 Further Motivation

A secondary aim of this paper is to discuss how one might generalize this particular feature of internal enforcement in an aim to further our understanding about the conditions under which self-enforcement can complement more formal enforcement mechanisms. We imagine that this type of internal enforcement mechanism is quite relevant, and plausibly is used in conjunction with other enforcement mechanisms. To give a simple example: each economic transaction produces a knowledge by-product, at the very least, the knowledge that such and such transaction voluntarily ocurred at such and such place and time. Each exchange then can be viewed as an extremely local innovation whose value is uncertain ex-ante as long as each party has any uncertainty about whether or not the party will perform the contractual duty under various conditions. Since the marketing of this local innovation

[8]The relational story in this paper suggests a negative correlation with the severity of termination and the coefficient they estimate is negative.

requires both the support of the principal and the agent, the internal enforcement mechanism discussed in this paper can assist contractual performance and support expectations that contractual performance will occur.

Postponing the discussion about generalizing this mechanism to section 7.1, we offer a few reasons why the particular enforcement mechanism discussed in this paper deserves attention. First, a better understanding of self-enforcement gives us a better understanding of the tradeoff between specificity and flexibility in the formal law. In the face of formal contract law, Scott [2003] argues for the importance of self-enforcing agreements and cautions against formal law discouraging norms of reciprocity. The formal law can also discourage the use of other self-enforcing agreements. Shapiro [1983] has a good example of how this works in the case of reputation. This paper's contracting environment offers the possibility to understand the negative effects of crowding out by formal law even when self-interested (in the narrowest sense) parties care only about the short-run.

This result leads to our second point. As North [1981] argues for the necessity of formal institutions for economic growth, we might reexamine the ability of informal institutions to promote economic growth, particularly when formal institutions are prohibitively costly. For instance, the results of this paper complement the claim made by Acemoglu et al. [2007] that technological innovation is less efficient when contracts are incomplete. Even though incompleteness results in less than optimal investment in new technologies, contractual incompleteness may provide an avenue for technological innovation when formal enforcement is costly or not possible. In fact, Scranton [2000] puts forth the thesis that specialty goods innovations, innovations that fit particularly well into our setting, were the main driving force of the second industrial revolution in the US.

Finally, from the development standpoint, institutional traps are hardly historical regularities yet it is hard to imagine if there are no such legal institutions or these institutions are weak how such institutional traps release. Self-enforcing agreements are cheap to enforce and can be used as an alternative to violence. They may create enough of a wedge between subsistence and surplus to invest in legal institutions which can secure peaceful interactions more broadly. Yet, working against both reputation and relational enforcement is their limit on the extent of the market as Greif [2006] has shown and, in fact, may give rise to violence at a larger scale pitting group against group. The mechanism discussed in this paper does not restrict the set of potential contracting parties so there is no a priori reason to presume it will limit the extent of the market.[9]

[9]We should note that our mechanism does assume some basic formal enforcement exists or, at least, some alternative enforcement, besides our mechanism, that enforces the fixed payment component of the contract.

2 The Model

2.1 One-shot Game

There is a principal (she) and an agent (he) who are both risk-neutral. In the producer/developer example, the principal is the producer and the agent is the developer. The principal has an idea about introducing a new product to the market. This product may or may not be valuable: if it is, which happens with probability p, its value to the consumer is V (and the principal, who markets the product, will be able to appropriate all of it in the form of the price she charges); with the remaining probability $1-p$ the product is of zero value. The principal has full bargaining power over the surplus; agent's opportunity income is W_a.

Introducing the new product requires both costs and luck. There are four components to the costs: setup costs c_f, production costs c_p, marketing costs, c_m and support costs, c_s. The agent chooses noncontractible effort level e, normalized to the probability that the product will in fact be produced; for that the agent bears production costs $C(e) = \frac{e^2}{2k}$, where k is low enough to make sure all relevant effort choices are in $[0, 1]$. If the agent succeeds in developing the new product, he delivers it to the principal who then has to spend fixed (small but positive) private marketing costs c_m to market it. Marketing the product also requires the agent to spend (also small but positive) support costs c_s.[10] If the product makes it to the market and turns out to be successful, the agent derives some positive private nonalienable noncontractible utility, which improves his opportunity income, W_a, and also lowers his fixed costs c_f in the future.

Here is the timeline:

1. Principal decides whether to attempt customized product (she will always choose in favor whenever she has an idea)
2. Principal contacts an agent and describes specification of the input. She offers him contractible salary s (to be paid upfront) and noncontractible bonus b, to be paid if the agent delivers the product.
3. If the contract is accepted, the agent bears fixed costs c_f and chooses effort level e.
4. With probability q the principal gets to privately observe the value of the product to the consumer (i.e., learns whether it is V or zero). This event is independent on the value.
5. The input is developed (or not) and delivered to the principal. If the input is not developed, the game ends.
6. The principal decides whether to honor her promise to pay the bonus.

[10] Some examples of products with positive support costs are durable goods, organic practices/certification, debugging, etc. See Masten and Kosová [2009] in a symmetric information and complete contracts setting.

7. The agent decides whether to provide support; if he decides not to, the game ends.
8. The principal decides whether to market the product (at private costs c_m); if decides not to, the game ends.
9. Output is produced and offered to the customer.
10. If it turns out to be successful (i.e., valued at V by the market) the agent gets expertise $\triangle W_a$ and his (discounted) costs of starting new projects in the future are reduced by $\triangle c_f$.

For future reference we assume $\triangle W_a = \triangle c_f$, that is, the extra expertise which the agent derives from successfully completing the project is purely general and not specific to the project. Technically this assumption is needed to simplify developing multiperiod model in the future: that way neither principals nor agents have any preferences about whom to be matched with (higher reservation wage is fully offset by lower setup costs for this agent). Or, more concretely, this assumption is illustrated through the paper submission example discussed in section 7.1: if a paper gets published, the author gets both credit and expertise, meaning that he is more efficient in writing subsequent papers (not necessarily for the same journal) but also that inviting him as a coauthor is now more difficult since his opportunity costs of time (in terms of participation in other potential projects) is now higher. This $\triangle W_a$ has to be high enough compared to support costs c_s so as to induce the agent to provide support if he believes that the principal has not received a negative signal. This amounts to assuming $c_s \leq \frac{p}{p+(1-p)(1-q)} \triangle W_a$.

Why would the principal honor her promise to pay the bonus? It is because otherwise the agent will believe that the principal lost hope in the product (i.e., got a negative signal). Indeed, if no bonus is given, the agent will not bother to provide support because he infers that the principal will not market the hopeless product and hence even small support costs are not worth spending. It is in order to signal that she still believes in the product (i.e., either got no signal or got a positive signal about the value to the customer) that the principal will pay the promised bonus.

What is the first best level of effort (i.e., what would the parties have chosen if it were contractible)? With probability e the product gets developed, then with probability $1-(1-p)q$ the principal does not get a negative signal and the two of them do spend their respective c_s and c_m (we assume that $pV > c_m + c_s$, i.e., in case of no signal it is still worth trying) and then earn their V, but have to spend development costs $C(e) = \frac{e^2}{2k}$. Overall, the maximization problem looks like

$$e\left[(1-q)(pV - c_m - c_s) + pq(V - c_m - c_s)\right] - \frac{e^2}{2k} - c_f \to \max_e,$$

so the first best level of effort is

$$e^{FB} = k\left[(1-q)(pV - c_m - c_s) + pq(V - c_m - c_s)\right].$$

Now that the effort level is not contractible, it is privately chosen by the agent in response to bonus promise. The agent realizes that the bonus will only be paid by the principal if she does not get a bad signal (i.e., if either she gets a good signal or no signal at all), which happens with probability $1-(1-p)q$, and then the agent will have to incur further costs c_s. If the bonus promise is credible, the agent will choose the effort level so as to solve

$$e(1-(1-p)q)(b-c_s)-\frac{e^2}{2k}+s-c_f \to \max_e,$$

so he will choose

$$e^* = k(1-(1-p)q)(b-c_s).$$

It is straightforward to see that the first best level of effort can only be supported by a bonus as high as $b^{FB}=\frac{pV}{1-q+pq}-c_m$. We now show that this high bonus payment is not credible: in case the principal gets no signal, her expected payoff from marketing the product is $pV-c_m < b^{FB}$, so in this case she will prefer not to pay the bonus and not to market the (already developed) product. Therefore, maximum credible bonus is only $pV-c_m$ which falls short of b^{FB} and hence the agent underinvests in developing the new product. Note that the level of inefficiency is an increasing function of the probability of signal q.

There is another implicit contracting arrangement similar to this one, in which the principal only pays the bonus if she receives a good signal about the quality of the project (rather than whenever she does not receive bad signal, as developed above). Although such an arrangement allows for a wider range of credible bonuses – indeed, the principal will now be prepared to pay as much as $V-c_m$ conditional upon receiving good signal – the effort level exerted by the agent for any given level of promised bonus is lower under this alternative arrangement, since the agent knows that he is less likely to receive the bonus if he succeeds in developing the product. It is routine to check that this alternative arrangement too fails to deliver first best level of agent effort or first best level of welfare. Which of the two arrangements is preferable depends on the value of parameters, in particular, on the value of q; we will reexamine the two alternative contracts in the dynamic setting in section 4.

Also, note, however, that although the first best is not achievable, as a second best outcome, either subjective bonus payment scheme allows for more innovations to enter the market than if no level of bonus payment were feasible.

3 Working Examples

To highlight the use of this particular enforcement mechanism, we present below a few examples.

1. *Biotech/pharma collaborative research example*: Gilson et al. [2009] highlight a class of contracts, exemplified by the contract of

Warner-Lambert and Ligand, between a large pharmaceutical firm and a small biotech firm who structure a collaborative research contract using terms that would be difficult to enforce by a third party. The pharmaceutical firm covers the marketing and commercialization of the drug and the costly process of FDA approval while the small biotech firm develops the drug (or several chemical compounds). The pharma company funds the research stage and offers a royalty on the revenues of the drug if it is finally marketed. The contract allows the pharmaceutical company to terminate the contract with little advanced warning, and if such a state does occur, the residual rights to the research return to the biotech firm. As Gilson et al. [2009] argue, reputational enforcement, while possible, is unlikely since observing who shirked is extremely difficult in such an environment. In this situation, Warner-Lambert who has experience both with the FDA and commercializing drugs likely will receive a private signal about the value of marketing the product after the drug gets developed but before the final FDA approval occurs. Warner-Lambert needs to communicate to Ligand that the product is a success by paying the bonus (in this case, but not exercising its unilateral right to terminate the relationship and avoid paying royalties to Ligand).[11] If the bonus is renegotiated or the relationship terminated, Ligand will likely have to abandon the project and look for funding elsewhere. After the initial research phase most of the cost that Ligand would face has been sunk, however, small support costs remain. Ligand still assists with the clinical trials. In Gilson et al. [2009], the argument is presented that after the development stage, no uncertainty remains and that an unanimous decision about continuing can be reached. But this is a strong presumption considering that the FDA process is by no means a certain process nor is consumer demand if approval occurs. While the parties may agree on whether or not the specific compound achieves the desired effect, they may have very different ideas about the commercial possibility and success of the drug. However, this asymmetric information allows for an implicit agreement to emerge, that continuation implies a positive view of commercial success. And termination implies a negative view.

2. *Modern agrifood industry example*: Modern agriculture, especially in developing countries, has changed dramatically since the liberalization movement and globalization. A major feature is the changing nature of procurement from the spot-market to procurement methods that rely on contracts with individual farmers. These contracts emphasize privately imposed quality standards, not only on traditional crops but also on new, high value, export crops. Farmers can expect to receive an explicitly or implicitly enforced premium if their product meets or surpasses the quality

[11] Ligand has some protection if Warner-Lambert opportunistically terminates. Warner-Lambert would not be able to market the drug for a specified period of time.

standards (Reardon et al. [2009]). Farmers must make costly investments to switch to high value crops that often require more labor intensive production methods and hence more problematic monitoring.[12] Despite this, studies have shown that contract farming does succeed in obtaining higher prices for better quality goods (Sethboonsamg et al. [2006], Bolwig et al. [2009], Ponte [2002]). In most cases, the contractual terms used in these contracts are not enforceable either because of difficulties in measurement of quality or because of weak legal institutions. Moreover, the implicit agreement between the farmer and the buyer are unlikely to be enforced by reputation and repeated interaction until the specialty market has been established in the area, and even then, it will be difficult for a buyer to commit to a long term relationship with any of the farmers and much less so for the farmers to have any impact on the reputation of the buyer.

In the case of coffee, the emergence of the specialty coffee market allows for brands to market geographic origin as well as production method. Another feature of contract farming is it enables traceability, a feature that is necessary when the actual production method matters, such as those involved in the sustainable production movement. Traceability also allows products to be classified by geographical origin. Consumer demand for specialty coffee, particularly those linked with a production/procurement method, such as organic, fair trade, direct trade, shade grown, wild, etc., is extremely uncertain, especially during the initial stages of the sustainable movement. Nevertheless, bonus payments were made for higher quality goods and our model explains why large companies were able to commit to paying such bonuses to individual farmers in developing countries. Otherwise, farmers would abandon the sustainable coffee movement. Consistent with our model is the fact that we see farmers who have switched to high value crops often switch back to domestic markets (which do not reward quality). Anecdotal evidence suggests that high rejection rates (of farmers' crops due to "poor" quality) may be one reason for this (Thome and Sexton [2007], Carletto et al. [2009]).

3. *The movie industry example*: Goldberg [1997] raises the issue about the net profits puzzle in the movie industry. The talent (writers and producers) contract with a studio on a movie. Very similar to the biotech/pharma contracts, the studio enjoys a right to terminate the relationship at very little cost. The commercial success of a movie is extremely uncertain and success can depend a lot on the efforts of the all parties involved. Often these contracts entitle the talent with a percentage of the net revenues. If a studio predicts little commercial success for a movie as it stands,

[12]Several studies note the difficulty in quality measurement in agricultural contracts, Saes [2005] and Hueth and Ligon [1999]

it may wish to employ a star. The problem is that stars demand a fixed payment plus a percentage of gross revenues, which eat into the bonus that the talent would receive.

Goldberg [1997] presents two cases, *Buchwald v. Paramount Pictures Corp.* and *Batfilm Productions, Inc. v. Warner Bros.* The former case results in the judge ruling in favor of the plaintiff on the grounds that the contract was unconscionable. In the later case, the judge rules that the contractual terms were not unconscionable since the plaintiff knew the movie industry well. Goldberg argues that both cases make irrelevant rulings since there is an economic logic to the net profits compensation scheme. In contrast, our model suggests that the unconscionable contractual terms is not the right argument. In the former case, asymmetric information about the value of the product is likely to exist but this opens the door for the signaling mechanism to work and enforce the bonus payment so the court should recognize the use of this and not rule in favor of the plaintiff.

4. *The editor and researcher example*: Consider the implicit agreement between a journal editor and a researcher in the paper submission process. The researcher promises to produce high quality research and the editor promises to publish such research if it is marketable; yet many authors of submissions will not publish for the same pairing of editor and journal (simply because most research will not get published) and, the peer-reviewed, double-blind nature of most submissions rules out strong reputational incentives. Nevertheless, many journals are successful at publishing high quality and marketable research without making explicit contracts with any one researcher.

   The editor has an interest in publishing high quality articles that the profession will cite. The researcher has similar incentives but clearly has a bias towards publishing his own research, regardless of its quality. Although quality of research may be observable, whether or not the research is marketable is much less certain. Once an editor decides that conditional on certain revisions, a manuscript should be published, the support costs of the authors are minimal compared to the value to the editor of making such revisions in order to market the product (the revealed difference between publishing and not publishing). This asymmetry provides incentives to both submit high quality research and publish marketable research because only through support of the authors do revisions take place (much more costly if non-authors were to do this) and since the editor uses peer review only through passing requirements on quality will the manuscript get published.

   There are clear costs to each party to submit to a particular journal, review the article and decide if it merits publication. The editor may know better than the researcher which articles will

sell well for the journal's targeted market but the researcher also has views about what will sell well and can approach different journals if the referee reports are unfavorable. The researcher assumes that if the article is of high quality and the conditions for publication are positive, the editor will publish it. According to our model, if this does not occur (the bonus is not paid) and support is withdrawn. A crucial aspect of our model is the fact that support is withdrawn and consequently the good is not marketed if the bonus is not paid. The bonus payment functions as a signal of the value of the product. If no payment is made, support is withdrawn because there is no reason to provide support for an unsuccessful product. Hence, important for our story, is evidence of withdrawing support after a bad signal despite the fact that these support costs are low. A revise and resubmit can be interpreted positively or negatively. If the revise and resubmit appears to not fit with the perception of the research by the researcher, the researcher may withdraw support and submit the article to a different journal. Again, the costs to revise are small relative to the benefit the journal receives from publishing the revised version. And it is unlikely that reputation and repeated interaction can enforce the journal editor/researcher implicit agreement.

5. *The expansion of trade example*: Consider the expansion of trade to new trade partners. An interesting example of this comes from explorers who would trade with local inhabitants but would never interact with them. A ship would stop in a natural harbor, near an inhabited island. Goods would be left on the beach by the inhabitants and the explorers would leave some goods in exchange. Who enforced this peaceful trade? The uncertainty of the value of the goods to the explorers allowed the what was left by them in return to function as a signal. If nothing or minimal goods were left in return, the local inhabitants would withdraw support by either appearing from hiding and expressing dissatisfaction (and non-peaceful interaction) or would not leave out future goods for other explorers. If this support was withdrawn, the explorers would have much greater difficulty marketing the goods they currently possess. One can easily generalize this example to a more modern context when one is considering expanding trade to a partner outside ones group and, hence, group-level enforcement mechanisms do not immediately take force.

4 Incomplete and Relational Contracting Benchmarks

In this section we compare the equilibrium outcome of the model outlined above against two benchmarks: (1) the null contract or incomplete contracting benchmark, in which the agent chooses effort at will and then, should his effort in developing the new product be successful, bargains with the principal about the devision of surplus and (2)

relational contracting, where the principal informally offers bonus to the agent in case his effort is successful, and her incentives to actually pay the bonus are governed by reputation concerns, as in Baker et al. [2002].

In order to simplify exposition we focus on the limiting case when setup costs c_f, marketing costs c_m, agent expertise W_a and support costs c_s tend to zero. In this case, the maximum credible bonus to be paid upon receiving no signal about the value of the project is $b = pV$, the maximum possible level of effort by the agent is

$$e = k[1 - q + pq]pV < kpV = e^{FB}$$

and the expected value of the implicit contract is $[1 - (1 - p)q]kpV \cdot pV - [1 - (1 - p)q]^2 kp^2V^2/2 = kp^2V^2[1 - (1 - p)^2q^2]/2$. Similarly, the maximum credible bonus to be paid only upon receiving positive signal equals V, it induces effort level $e = kpqb = kpqV < kpV = e^{FB}$ and delivers value of the contract equal to $kp^2q^2V^2/2$. It is straightforward to compare the two contracts and to conclude the the former is preferable for $q < 1/\sqrt{1 + (1 - p)^2}$ while the latter is preferable for $q > 1/\sqrt{1 + (1 - p)^2}$. Denoting the value of optimal implicit contract by V_0 we therefore obtain

$$V_0 = \begin{cases} kp^2V^2[1 - (1 - p)^2q^2]/2, & q \leq 1/\sqrt{1 + (1 - p)^2}; \\ kp^2q^2V^2/2, & q > 1/\sqrt{1 + (1 - p)^2}. \end{cases} \quad (1)$$

In order to avoid further dealing with multiple cases we restrict our attention to low values of q; specifically, in what follows we make the following

Assumption 1. The probability of the principal receiving a signal about the value of the product is low compared to the probability that the value is high: $q \leq \frac{1}{2-p}$.

Under Assumption 1 the value of the optimal contract is $V_0 = kp^2V^2[1 - (1 - p)^2q^2]/2$.

Note that in both benchmark cases outlined below the equilibrium level of the agent's effort never exceeds e^{FB}; therefore, since the value of the relationship is an increasing function of agent's actual effort e for $e \leq e^{FB}$ it suffices to compare the equilibrium level of effort in alternative contractual arrangements. An arrangement that induces higher level of effort is superior.

4.1 No Contract Benchmark

In this subsection, we compare our contractual arrangement to that without any contract, explicit or implicit. Under no contract, the game proceeds as follows. First, the principal describes the product she desires to an agent. The agent then chooses his effort level, e, at costs, $C(e) = e^2/2k$; meanwhile, the principal privately observes her signal about the value of the project (V or 0) with probability q, independently of the actual realization of the value. If the agent succeeds in developing the new product (which is observable by both

the principal and the agent), the principal and he then bargain about the devision of the surplus ex post.

To keep the exposition tractable, we assume a reduced form bargaining game.[13] In this game, either the agent (with probability $\pi \in [0,1]$) or the principal (with probability $1-\pi$) gets to make a single take it or leave it offer to the other party. Following the offer, the game ends; payoffs are either specified in the offer if it is taken or zero to both parties if it is not. Parameter π reflects relative bargaining positions of the two parties: $\pi = 1$ (respectively, $\pi = 0$) corresponds to the agent (principal) having full bargaining power. We assume that the choice of who gets to make the (single) offer is independent of other random variables (i.e., on the value of the project and whether the principal received her private signal or not).

We now solve for the equilibrium level of effort in the no contract setup. First, we solve for the equilibrium in the bargaining game. If the principal makes the offer, she will appropriate the entire ex post surplus by offering the agent a minimum price for the product. If the agent makes the offer, he has two meaningful options: offer to supply the product at a price just below V, in which case the principal accepts only if she received a positive signal about the value of the project (which happens with probability pq); or offer to supply the product at price just below pV, in which case the principal accepts if she received either a positive signal or no signal about the value of the product (which happens with probability $1-(1-p)q$). Therefore, the choice of the agent depends on which of the two values pV or $[1-(1-p)q]pV$ is higher. It is straightforward to conclude that the agent will choose to offer V if $q \geq 1/(2-p)$. His ex post payoff, in case the product is successfully developed, equals πpqV.

Second, we solve for the equilibrium level of agent's effort in the case of no contract. If $q \geq 1/(2-p)$, the agent chooses e to maximize $e\pi pqV - e^2/2k$ and will choose $e = e^{NC} = k\pi pqV$. Comparing e^{NC} to e^{SB}, derived in the previous section, allows to conclude the following:

Proposition 1. Under Assumption 1 the agent's effort and the expected value of the arrangement are always at least as high under implicit contract without reputation (described in section 2) than under no contract, and are strictly higher as long as $\pi < 1$.

Unlike in Che and Hausch [1999], even though the agent's effort is a cooperative investment, contracting can have value. In our setting, the identity of the principal matters: the agent understands differently a principal who does not signal with bonus to one who does. In this sense, if no contract approximates market anonymity, implicit contracting without reputation is close to anonymity but stands apart from market exchange.

[13] We focus on case $q \leq 1/\sqrt{1+(1-p)^2}$ so as to deal with one particular case for V_0; the complementary case $q > 1/\sqrt{1+(1-p)^2}$ is analyzed similarly.

4.2 Relational Contract Benchmark

In this subsection, we compare our setup with that of Baker et al. [2002] in terms of induced agent's effort level and overall efficiency. A relational contract, as defined in Baker et al. [2002], involves a bonus b^{RC}, promised by the principal to the agent in the case when the agent succeeds in developing the project. The principal's incentive to honor her promise is reputational: if she fails to do so, neither will the agent in question nor any other agent deal with the dishonest principal in the future, causing her to lose potential value every period on (opportunities for interactions between the principal and an agent are assumed to arise every period in the future).

Following Baker et al. [2002], we focus on an equilibrium which involves the agent quitting the relationship forever (and no agent entering it in the future) upon the principal failing to pay the bonus when it is due, i.e., when the agent successfully produces the product. Our setup, with the principal receiving a signal about profitability of the project prior to deciding whether to honor her promise to pay the bonus, allows for a richer strategy space than does the original Baker et al. [2002] formulation. Indeed, there are now three potentially profitable long term contracts, desirability and feasibility of which we have to assess; these three types differ in the range of signaling situations in which the principal is prepared to honor her bonus promise. The most direct expansion of the original model involves the principal honoring her promise to pay the bonus irrespective of whether she obtains a signal, in particular, when she obtains negative signal. A relational contract which can be referred to as 'no negative signal' contract involves the principal honoring her promise to pay the bonus as long as she does not receive negative signal, i.e., she either receives a positive signal or no signal at all. Finally, a 'positive signal' contact may involve the principal only honoring her promise to pay the bonus if she obtains a positive signal about the value of the project.

It is not possible to compare contracts of these types, either with each other or with repeated static implicit contract, on an a priori basis. The contracts can easily be ranked in terms of incentives for the agent. For any *given* level of the bonus, the level of effort induced by the contracts of the three types above is decreasing (in the order presented), since the probability that the agent will receive the bonus decreases for any given level of effort. However, the *range* of feasible bonuses possible under each type of contract has a countervailing effect. The range expands as the probability of payment decreases since the principal's incentive compatibility constraint is less demanding – i.e., compared to the standard relational contract, higher bonuses are feasible if both the principal and the agent understand the the principal will not pay the bonus if she gets a negative signal, and yet even higher bonuses are feasible if the principal is only expected to pay the bonus if she gets a positive signal. Importantly, the following lemma allows us to restrict the analysis to just one type of reputational contract.

Lemma 1. Self-sustaining reputational contracts in which the principal (i) only honors her promise to pay the bonus if she does not

receive negative signal or (ii) only honors her promise to pay the bonus if she receives a positive signal deliver a level of effort no greater than that delivered by a repeated optimal static implicit contract.

Proof of Lemma 1. We first prove part (ii). At any offered bonus b, the agent, realizing that the bonus will only be paid with probability pq if he delivers the product, will choose effort level e so as to maximize $pqeb - e^2/2k$ and so will choose $e = kpqb$. Assume for a moment that the credibility of the bonus payment is not an issue; the principal will then want to choose bonus b so as to maximize the per period value of the relationship (by optimally choosing wage s the principal can always leave the agent at his reservation utility level). This ex ante period value of the relationship is given by $pqeV - e^2/2k$ (which implies possible ex post losses: the product will not be developed if the principal fails to receive a positive signal about it, even though the project may still be profitable) and is maximized at $e = kpqV$, which can be supported by bonus $b = V$, credible not only in a repeated but also in a static relationship – conditional on receiving positive signal the principal will be willing to offer any amount up to the value of the project V. Therefore, repeated interaction 'positive signal' contract cannot improve upon the static 'positive signal' contract with bonus $b = V$, which proves part (ii) of Lemma 1.

Proving part (i) is slightly more complex. Similar to the above, the agent, when offered bonus b, understanding that the principal will only honor her promise to pay the bonus if she does not get a negative signal, chooses effort level e to maximize $(1-(1-p)q)eb - e^2/2k$ and hence will choose $e = (1-(1-p)q)bk$. For any level of bonus b the principal will be able to offer wage $s = -\frac{k}{2}(1-(1-p)q)^2b^2$ so that the agent is indifferent between accepting the contract and not.

For any level of bonus b denote by $U(b)$ the present discounted value of the reputational contract that involves the principal reneging on the bonus payment if and only if she does receives a negative signal; denote by V_0 the value of one period static implicit contract that involves the optimal bonus (i.e., bonus $pV/(1-q(1-p))$ for $q \leq \sqrt{\frac{1}{1+(1-p)^2}}$). Then the following equation holds for $U(b)$:

$$U(b) = \frac{k}{2}(1-(1-p)q)^2b^2 + (1-(1-(1-p)q)bk)\frac{U(b)}{1+r}$$

$$+(1-(1-p)q)bk\cdot(1-(1-p)q)\left[\frac{pV}{(1-(1-p)q)} - b + \frac{U(b)}{1+r}\right] + (1-(1-p)q)bk\cdot(1-p)q\frac{V_0}{r}. \quad (2)$$

Expression (2) is intuitive. The discounted present value of the contracting arrangements includes the salary expense $-s$, which is the first term of the expression. The second term in (2)follows from the fact that with probability $1-e$ the agent fails to develop the required product, in which case no further transaction is due in the current period, and the relationship passes on to the next period. The discounted present value of the relationship in the next period is $U(b)/1+r$ where r is the interest rate faced by the principal. The third term in (2) accounts for the fact that with probability $e\cdot(1-q(1-p)$ the product is successfully developed, while the principal does not get a negative

signal about it; in this case the principal pays the bonus, markets the product, receives expected payoff $U(b)/1-q(1-p)$ and the relationships pass on to the next period. Finally, with probability $eq(1-p)$ the product is developed, but the principal learns bad news about it, decides to renege on bonus payment and the relationship is destroyed, in which case the principal receives V_0 in every period starting from the next period; this explains the last term.

From (2) it is straightforward to compute that

$$U(b) = (1+r)k(1-(1-p)q)b\frac{(1-(1-p)q)b/2 + pV - (1-(1-p)q)b + (1-p)qV_0/r}{r + kb(1-(1-p)q)(1-p)q}. \quad (3)$$

It is easy to verify that $U(b)$ obtains unique maximum at some point b^* such that $pV < b^* < pV/(1-(1-p)q)$. Note that $U(pV) = (1+r)V_0/r$ for $q \leq 1/\sqrt{1+(1-p)^2}$ – a reputational contract where the promised bonus is equal to the maximum credible static bonus is equivalent to the optimal repeated static contract, if the latter involves the principal paying the bonus upon receiving no signal. For $q < 1/\sqrt{1+(1-p)^2}$ it immediately follows that $U(pV) < (1+r)V_0/r$.[14]

The last step is to verify that no promise to pay a bonus higher than pV is incentive compatible for the principal. Indeed, the principal must be willing to pay the bonus upon receiving no signal about the profitability of the project. If she does, she loses b but gains on average pV in the current period, while maintaining the relationships worth $U(b)/1+r$ from next period on; if instead she reneges on the bonus payment, she saves b but forgoes pV and relationships slide to the repeated static informal contract, worth V_0 in every period starting next period; therefore, the principal's incentive compatibility constraint looks like[15]

$$-b + pV + \frac{U(b)}{1+r} \geq \frac{V_0}{r}. \quad (4)$$

Since $U(pV) \leq (1+r)V_0/r$ as noted above, to demonstrate that constraint (4) is never satisfied for $b > pV$ it suffices to show that

[14] An alternative interpretation of the relational contract could require that no agent contracts (inclusive of static implicit contracts) with the principal following a failure to honor the bonus payment. We choose to employ the notion of the outside option that once the principal reneges on her promise to pay bonus, the agent – or any other agent for that matter – still trust her enough to sustain a one-shot relationship. This assumption is nontrivial, given that this one-shot relationship involves signaling and hence presumes some degree of trust between the parties. Indeed, there is another equilibrium in the game, which involves the principal offering zero bonus and the agent not believing in any bonus promise and hence choosing zero effort; this equilibrium arguably exhibits less trust than the one proposed in section 2. While assuming either continuation equilibrium upon the principal breaking her promise to pay bonus – an off-equilibrium event – requires further motivation, either assumption is consistent with the logic presented below but we focus on this notion in order to isolate the marginal value of using the relational contract when static implicit contracts are available

[15] This is not the only principal's incentive compatibility constraint – the other one is that the principal should indeed be willing to renege on the bonus promise upon receiving a negative signal. This other constraint is, however, not binding for any $b \geq pV$.

$U'(b) \leq 1 + r$ for these values of b. This is straightforward to check. This completes the proof of Lemma 1.

Therefore, the only reputational contract that remains to be considered is the one where the principal always honors her promise to pay the bonus in equilibrium, even upon receiving negative signal about the value of the project. If bonus b is credible, the agent will be choosing effort e so as to maximize $eb - e^2/2k$ and so will chose $e = bk$. The principal's (ex ante) period payoff, net of agent's compensation, will then equal $V(b) = epV - e^2/2k = kbpV - kb^2/2$.[16] The principal's incentive compatibility condition that assures her willingness to pay bonus b is then given by

$$b \leq \frac{V(b) - V_0}{1 + r} + \frac{V(b) - V_0}{(1 + r)^2} + \cdots = \frac{V(b) - V_0}{r}.$$

If r is low enough (i.e., $r \leq (kp^2V^2/2 - V_0)/pV$) so that the first best level of bonus $b = pV$ is credible, then the reputational mechanism proposed by Baker et al. [1994] delivers first best level of effort $e^{FB} = kpV$; if r is high enough so that no positive level of bonus is credible (i.e., $r > kpV - \sqrt{2kV_0}$) then the reputational contract arrangement is not feasible, and the only option is repeated static implicit contract. For an intermediate level of interest rate there is a maximum credible bonus $b < pV$, which delivers effort level $e < kpV$. Note that at q close to zero or one even at moderate level of interest rate r, the reputational contract is not feasible since V_0 approaches first best value $kp^2V^2/2$ and hence the threat point fails to be unattractive enough to prevent the principal from reneging on her bonus promise.

We conclude this section by commenting on whether the principal would prefer to have a signal about the value of the project if she had a choice. The answer is ambiguous as follows from the logic parallel to that developed by Baker et al. [2002] for a verifiable but imperfect signal about the agents effort. Indeed, as we saw, implicit static contract fails to deliver first best value, but may be the only available option, particularly if interest rate r is high enough not to allow for any reputational contract. At the same time, for low or moderate values of r availability of the signal about the quality of the project is deteriorating for efficiency since it improves principal's payoff upon reneging on bonus promise and hence undermines her incentives to pay bonus in the first place. Therefore, depending on values of the parameters (in particular, q and r) the principal may or may not prefer to have a technology that produces a signal about the value of the project.

5 Comparative Statics

In this section we study how the value of contractual arrangement introduced in section 2 varies with changes in the parameters. To keep

[16] Following Baker et al. [2002], we assume that the principal has full ex ante bargaining power and so can appropriate the entire ex ante expected surplus by choosing an appropriate salary s – possibly negative – to pay the agent irrespectively of how successful the project is.

the analysis tractable we focus on the limiting case as in section 4, so that formula (1) for the value of the contractual arrangement applies.

First, we compare two production technologies for the input, one of which requires positive (even arbitrary small) support costs while the other does not. These can be thought of as innovative and traditional processes, respectively. Note that either of these two technologies can be employed in producing a new good with uncertain consumer value; indeed, the novelty or demand uncertainty associated with the product developed in the relationship that we study do not necessarily translate, at least in theory, into the novelty of the production technology; therefore it is legitimate to consider using a generic technology to develop the new product.

It follows immediately that if the principal, when contracting with the agent, has a choice between traditional and innovative production technologies, with the latter requiring support costs (and both requiring marketing costs, since the product itself is new and of uncertain consumer value) the principal should opt for the latter one. Indeed, positive (however small) support costs are the only mechanism that induces the principal to honor her promise to pay the bonus; once support is not needed anymore, the principal has incentives to renege on her bonus promise; knowing that the agent will not exert effort.

Similarly, if the choice between traditional and innovative production technologies is not contractible (though observable to the principal) and, therefore, is to be made by the agent unilaterally, the agent will opt for the technology that requires support; indeed if he does otherwise, the principal, upon observing that no further action by the agent is required, will have incentives to renege on her promise to pay the bonus. Note that both conclusions do not depend on parameters of the model.[17]

This confirms the earlier motivation of implicit contracts and collaborative innovation. If idiosyncratic uncertainty is present, collaborative relationships appear to be a response. Choosing a technology that requires support gives the appearance of a collaborative relationship even though alternative research arrangements are technically feasible. Or, in the case of the movie industry, the talent and the studio may choose to produce the film using support of the talent after the film has been made precisely to better provide incentives for the talent to develop a marketable film.

Next compare two technologies different only in their risk level. That is, assume that there are two ways ($i = 1, 2$) to produce the input, with identical cost parameters k, and identical expected value

[17]If the choice of the technology is made solely by the agent and is not observable to the principal even ex post, the problem becomes more complicated. Indeed, if traditional technology is less risky – i.e., has higher probability of success p – the agent has incentives to choose it, when the principal believes he has chosen an innovative technology instead. The result will be a mixed strategy equilibrium with the agent choosing either technology with positive probability and the principal (upon not receiving negative signal about the consumer value of the product) mixing between honoring her promise to pay the bonus and reneging on it, in hope that the technology will require no support.

$p_1V_1 = p_2V_2$, but assume that technology 1 is less risky: $p_1 > p_2$ (so that $V_1 < V_2$). Note that the first best level of effort $e = kpV$, as well as the first best value of the arrangement, is identical for the two technologies. It follows immediately from (1) that the value of the arrangement is the same if the bonus is only paid upon receiving a positive signal (indeed, only expected value pV factors in at any step of the calculation); it follows further that when the principal is paying the bonus upon not receiving a bad signal, the value is higher for the less risky project.[18] This result is intuitive. The size of the credible bonus, to be paid whenever the principal does not receive a negative signal, is limited by the expected value of the project, assumed identical across the two technologies. For a fixed bonus level, the agent will exert higher effort if the probability of receiving this bonus, equal to the probability of principal not receiving negative signal, is higher. That probability is higher if the project is less risky.

We have therefore obtained that if the principal has a choice between two technologies with the same expected payoff for any given level of agent's effort, she will choose the less risky one (even though a priori both the principal and the agent are assumed risk neutral). It is straightforward to check that if the choice of the technology is made by the agent, he too will prefer a less risky technology for any given level of bonus. Summarizing, we have the following

Proposition 2. If two technologies with the same expected value are available, different only in the level of risk, both the principal and the agent will prefer the less risky one. This result is independent of the contractibility of the technology choice.

At first glance, this is a startling result and one that reinforces the difficulty that developing countries with imperfect enforcement of contracts have in innovating. Venture capital from the outside is more attracted to high risk, high return investments than safer innovations that still may fail and even if successful may be expropriated. From a policy perspective, this result may shed light on why some high risk technologies are not adopted when there is a low risk alternative even when insurance accompanies such technological adoption as in Ginè and Yang [2009]. When contracts lack enforceability, parties may not be able to coordinate on the high risk technology since both face pressure to choose the low risk technology.

6 Implicit contracting: further comments.

In this section we offer several remarks about the static implicit contract that we develop.

First, it is important to stress that we assume the size of the bonus to be fully contractible and indeed written into the contract. What is not contractible is the contingencies under which the bonus is due. We

[18] At intermediate values of q the principal will pay the bonus for the high risk project only upon receiving a positive signal, while pay bonus for low risk project upon not receiving negative signal; again, the value of the less risky project is higher.

have in mind a contract which specifies that once the input is delivered, the principal, upon recognizing the delivery, must sign the delivery confirmation. A signed confirmation is the document that allows the agent to claim the prespecified bonus; courts can enforce this claim. Signing the document, however, is at sole discretion of the principal; she may choose not to sign it, claiming that the agent did not deliver the input, whether or not the agent actually did; the court is unable to verify the delivery (only whether the delivery confirmation is signed). This view on implicit contracting reduces the principal's strategy space to only two actions, i.e., paying the bonus or not (compared to the setup where the principal could have full discretion over the size of the bonus). If we assume this approach, we do not have to worry about the agent's strategy off the equilibrium path, and, in particular, our equilibrium automatically satisfies requirements on off equilibrium beliefs (such as imposed by the Cho-Kreps intuitive criterion).

It is also natural to consider more general contracts, brought by what can be referred to as a mechanism design approach. Applying the revelation principle we restrict attention to direct mechanisms, in which the principal – the informed party – upon observing that the agent successfully developed the input, announces the state, i.e., whether she has received a signal about the value of the project and, if so, whether the signal is positive or negative. In each state the mechanism will then prescribe the probability with which the project is continued and the bonus to be paid; such mechanism must be incentive compatible, i.e., it must be in the principal's interest to announce the state faithfully. Without loss of generality, we may focus on direct mechanisms that involve zero probability to continue and zero bonus in the state when the principal receives a negative signal. It is routine to check that the contract we suggest (involving bonus of size pV and probability one to continue in both the other states) is indeed the welfare maximizing mechanism under Assumption 1.

Finally, we note that the contract we suggest is immune to the possibility of renegotiation, at least if renegotiation is assumed to take place before the principal decides whether to pay the bonus. There is no conventional way to model renegotiation under asymmetric information; for our purposes we can adapt the model proposed by Hart and Moore [1988]. If both parties have a limited number of discrete time periods to propose alternative contracts (possibly specifying different bonus payments) after all uncertainty is realized – that is, after the principal observes her signal and the agent develops or fails to develop the input – it is straightforward to conclude that our contract will withstand renegotiation. Indeed, there is little the agent, being the uninformed party, can propose; the principal may propose a contract stipulating a lower bonus, but it would not be rational for the agent to accept, as he will rationally expect that when the time comes to either sign the delivery confirmation or not, the principal will choose to do so for fear that otherwise the agent will infer that she had received a negative signal and will withdraw support.[19]

[19]This argument does not apply if there is an option to renegotiate after the principal

7 Future Directions

7.1 Generalizing the Mechanism

We imagine a generalization that is expressed by the following mechanism: each party has an incentive to perform contractual duties in order to properly assess the value of the local innovation. The contract represents a reference point necessary to compare the contractually determined outcome with potential future contracting opportunities (outside the relationship and not affected by the outcome of the contract except through the knowledge gained by the contracting party).

When contractual performance alters the joint surplus and underlying asymmetric information about how performance affects surplus is present, incentives exist for each party to perform relatively close to contractual duty in order to have less noisy information after observing outcomes and any uncertainty is resolved.

Using behavioral assumptions, Hart and Moore [2008] argue contracts can function as reference points. In their set-up, contracts can manipulate expectations about entitlements against which contractual parties measure the "fairness" of outcomes and accordingly perform contractual duties to reflect the difference between expected entitlement and actual outcome. However, contracts can serve as reference points in other ways. This paper suggests that contracts can also establish expectations that allow parties to learn in the face of two-sided uncertainty about overall surplus created by the economic transaction. In other words, if alternative expectations, ones not influenced by the contract, had been in place, yet a similar outcome to the contract were externally imposed, parties would learn less. Here, the instability of the environment is important to limit the contractual difficulties associated with asymmetric information.

7.2 Theoretical Extension

An important extension to this paper is an extension to the enforcement externalities discussed in Kranton [1996] and others. In the context of contracts, an enforcement externality is when the use of one enforcement mechanism by parties to a contract affects the value of using an enforcement mechanism for parties to a different contract. In Kranton [1996], using reciprocal exchange makes the market thinner, making market exchange more costly. In our context, the use of external enforcement such as objective quality standards (as in Shapiro [1983]), i.e. a minimum number of mathematical equations in order to offer a revise and resubmit, may affect the signaling value of the no bonus payment. If there is no signaling value then the principal can not credibly commit to paying a subjective bonus and implicit contracting without reputation loses force.

decides whether to pay the bonus or not; we do not study this case here.

8 Conclusion

In the face of dynamic, short-term uncertainty, implicit contracts can emerge to support local innovations. These types of contracts are superior to the standard incomplete and relational contracting benchmarks precisely in environments with high interest rates and/or high uncertainty. In order to achieve this result, we rely on an enrichment in the contracting environment that allows for support costs, which are small but potentially very powerful. If support is not given, the product can not be marketed. Importantly, when the short-run and long-run value of a new product is uncertain, the principal can signal the value of the project so that the agent will continue to participate in the production process.

Norms of fairness can also explain subjective bonus payments in such environments. In some sense, our model together with related models can be used to understand fairness, trust, and reciprocity as self-interested behavior, implying that self-interested behavior can explain cooperative agreements in a broader setting than previously had been recognized.

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