Relational Contracts, Growth Options, and Heterogeneous Beliefs: A Game-Theoretic Perspective on Information Technology Outsourcing

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ABSTRACT: More companies have realized that information technology (IT) outsourcing, once viewed as a cost reduction tool, could facilitate and even enable the transformation of their core business processes. The benefits from a potential outsourcing relationship expansion have strategic implications for relational incentive provision. Modeling “information poaching” in IT outsourcing as an incentive problem with contractibility constraints, our analysis shows that this problem could be mitigated in a repeated game where the outsourcing client and the service provider agree on a relational contract. When the two partners share the belief that they can potentially benefit from a future relationship expansion, they are more likely to behave cooperatively during the early stages of their relationship. However, when they disagree about the likelihood of the future relationship expansion, they will have different preferences on a set of otherwise equivalent relational bonus contracts. Specifically, they will adopt a relational contract with large but infrequent bonuses when the client is more optimistic than the service provider about the potential of their relationship. Because these results hold even when the sourcing partners’ beliefs are very close to each other, our analysis sheds fresh light on the issue of equilibrium selection in relational contract theory. In the context of IT outsourcing, the results of this study suggest that, because salient forms of relational bonuses are often not adopted, relational incentive provision is likely more pervasive than what we can observe.

KEY WORDS AND PHRASES: contractibility, equilibrium selection, growth options, heterogeneous beliefs, IT outsourcing, outsourcing contracts, relational contracts, repeated games.
Those whose courses are different cannot lay plans for one another.
—Confucius, *The Analects* (ca. 500 B.C.E.)

In most respects matters become more difficult when there are no policemen to whom one can appeal, because only self-policing agreements are then worth the paper on which they are written.
—Ken Binmore [9, p. 109]

To continuously improve supply chain efficiency in an increasingly competitive global market, companies have to proactively collaborate with each other. Very often business collaborations necessitate transferring valuable and proprietary information beyond companies’ boundaries. The rapid advance in information technology (IT) and the ubiquity of the Internet, mainly through facilitating information exchange among business partners, have dramatically extended the scope of interorganizational collaboration. An excellent example is the gigantic and rapidly growing IT outsourcing marketplace, which has been a major catalyst for many companies’ campaigns to revitalize their supply chains. Once simply viewed as a tool to reduce IT costs, outsourcing is evolving quickly to encompass many aspects of a company’s strategic initiatives, facilitating and sometimes even enabling the transformation of its core business processes. Several recent empirical studies have suggested that IT outsourcing has substantially and consistently increased industry output and productivity across many different industries [17, 38, 40].

As more and more companies view outsourcing in a broader strategic context, they have realized that the potential of an outsourcing relationship could be significantly underestimated if they maintain the cost-cutting, procurement-based mind-set in relationship development. In reality, many strategic outsourcing partners nowadays have developed hand-in-glove relationships enabling them to dynamically adjust the scope of their collaboration through learning and adaptation. For example, on April 16, 2009, IBM announced that Daishi Bank in Japan had extended its outsourcing contract with expanded scope for an additional six years. While for years IBM has been promoting the strategic value of “transformational IT outsourcing” to its outsourcing clients, many Indian IT outsourcing giants have recently started to recognize the potential of broadening their IT outsourcing service, aggressively competing for higher-level and wider-ranging outsourcing deals that usually go to their major U.S. competitors including IBM, Hewlett-Packard, and Accenture [70]. Like earlier studies that promote “options thinking” in strategic IT decision making [7, 30, 47, 58], the current paper advocates the view that the growth options associated with a relationship expansion could impact incentive provision and contract choices prior to the expansion, thereby yielding new implications for managing and developing outsourcing relationships.

Generations of business researchers have extensively studied various incentive problems that lead to exchange opportunism and contractual hazards. Through the lens of modern contract theory and incentive theory, these studies have systematically examined the agency problem caused by asymmetric information and the hold-up problem caused by contractual incompleteness (e.g., [36, 44, 56]). A significant incen-
tive problem in strategic outsourcing results from the vulnerability of the transferred information to misappropriation and exploitation \[19, 39\]. In the standard supply chain or channel context, information imperfection creates incentive distortions, and as a result most models focus on effective communication strategies (e.g., \[14, 24, 55\]). When a company misappropriates its partners’ information, its incentives primarily come from the value of using the information for unauthorized but profitable purposes. Because misappropriating information tends to harm owners of the information, Clemons and Hitt \[19\] describe it as “poaching.” In our paper, we use poaching, information misappropriation, and information exploitation interchangeably. It is worth noting that information poaching can be considered as an example of losing intellectual property through outsourcing. Glass \[33\] develops a theoretical model focusing on the impact of intellectual property protection on the extent of outsourcing. Several more recent studies have highlighted defending intellectual property as a major concern for outsourcing firms (e.g., \[41, 68\]). Our model can be readily extended to address the Internet protection issue for many types of outsourcing relationships.

To study the interplay between incentive provision and relational adaptation, we analyze the poaching problem in an IT outsourcing model where a client company (she) sources one of her information systems functions to an outside IT service provider (he). Our model depicts an incomplete contract environment where information misappropriation is unverifiable and ipso facto explicit contracting on misappropriation is infeasible. Because of the contractibility problem, the IT service provider always has an incentive to exploit his client’s transferred information in a one-shot sourcing transaction. Being aware of his incentive for information exploitation, she has to spend some resource to protect the valuable information to be transferred, which consequently blocks first-best implementation and reduces joint surplus. Examples of technical information protection include information encryption, product/process modularity, and seeding dummy information \[19\]. It is worth noting that firms can also protect their information using some nontechnical method (e.g., \[52\]). For example, information monitoring and auditing can improve observability, which consequently makes it viable to prevent information poaching through formal incentive contracts. In some other situations, mechanistic governance may provide the appropriate solution (e.g., \[72\]). In our repeated sourcing game whose stage game matches the one-shot sourcing game, poaching could be avoided when the two forward-looking sourcing partners play a more efficient relational sourcing equilibrium in which the service provider never misappropriates the client’s information. Our analysis further suggests that the sourcing partners, with the common understanding that the scope of their relationship could be extended if warranted, are more likely to adopt a relational contract during the early stages of their relationship.

Our study belongs to a theoretical literature that uses repeated games to model self-enforcing relational contracts \[4, 5, 6, 12, 18, 31, 54\]. In the extant information systems (IS) literature, several studies have highlighted the significance of relational governance and contract incompleteness in the context of IT outsourcing \[25, 48, 67\]. Our study contributes to this literature by formally analyzing how to use relational contracts to provide incentives in an incomplete contract environment. Several
economics papers have suggested that real options models can be used to decide which proportion to produce in-house and which proportion to outsource [1, 71]. The current study considerably differs from these studies by focusing on the growth options (rather than the embedded deferral options) associated with an outsourcing relationship. In addition to incorporating “options thinking” into the analysis of relational contracting, this paper extends this literature by explicitly studying the role played by information structure problems such as heterogeneous beliefs in influencing equilibrium coordination in long-term business relationships.3 Specifically, when the sourcing partners disagree about the likelihood of the future relationship expansion, they will have different preferences on a set of otherwise equivalent relational bonus contracts. Consequently, the client will have an incentive to pay large but infrequent bonuses when she is more optimistic than the service provider about the potential of their sourcing relationship. Furthermore, our analysis shows that this incentive will not disappear under a more general scenario where the client is only marginally more optimistic than the service provider.

Despite the theoretical nature of this study, the main results of our model are empirically relevant in the context of relational outsourcing. In the real business world, it is not uncommon for the duration of a new outsourcing contract to span more than five years. The model provides one rationale for this observation: A sourcing client with a more optimistic view on relationship potential prefers contracts with longer duration because they provide the client more flexibility to defer relational bonuses (lowering transaction costs is another rationale for using long-term contracts). Our modeling framework also emphasizes that exogenous events often trigger mutually beneficial contract renegotiations under long-term contracts. According to a recent report by Goolsby [35], more than one-third (38 percent) of the 92 outsourcing relationships it studied in 2008 and 2009 renewed their deals early, before the original contract renewal dates. The early contract renewal rate for IT outsourcing deals was even higher (almost 50 percent). Our results also highlight the role played by the relationship expansion option in influencing relational incentive provision. According to Deloitte Consulting’s 2008 Outsourcing Report [23], 68 percent of the executives surveyed said their largest outsourcing contracts included the flexibility of changing the scope of services. Whether such flexibility is associated with higher degree of relational governance in the early stages of an outsourcing relationship is apparently an empirically testable question.

The next section of this paper presents our model of one-shot sourcing transaction between the client and the service provider. In the third section we construct a repeated sourcing game and characterize its relational sourcing equilibrium. A set of equivalent relational bonus contracts within a reneging constraint are also characterized. In the following section, we analyze how the prospect of a relationship expansion influences incentive provision and relational contracting. We allow the sourcing partners’ beliefs on the likelihood of a relationship expansion to differ (either significantly or marginally) in the fifth section, which leads to some fairly general results on equilibrium refinement. The last section offers more discussions and concludes the paper.
The One-Shot Sourcing Game

We model the one-shot sourcing transaction between the client and the IT service provider as a one-shot sourcing game that, as mentioned before, matches the stage game of our repeated sourcing game to be discussed in the next section. Two players, the IT service provider and the client, decide whether to engage in a one-shot sourcing transaction. The incentive for the client to outsource comes from the cost advantages enjoyed by the service provider in implementing an IT function. The cost for the client to internally implement the function is $S (S > 0)$ and the cost for the service provider to do the same job is normalized to 0. So the maximum surplus available from this outsourcing transaction is $S$. The client offers the service provider $m (m \geq 0)$ for his service. Upon his acceptance of her offer, the client decides whether to incur cost $c (c > 0)$ to protect her information to be transferred to him. Our model assumes that the service provider cannot exploit the information once it is protected. A more general assumption is that protected information is less likely to be exploited by the service provider than unprotected information. However, this generalization does not alter any insights from our model and is therefore not adopted for notational simplicity.

If the client chooses not to protect her information, the service provider has the option to poach the unprotected information. If the service provider exercises this option, the client will lose $L (L > 0)$ and he will gain $G$. We assume that the benefits from poaching outweigh the costs associated with it (i.e., $G > 0$). So reputation concerns and potential legal costs are not sufficient to stop the service provider from poaching in our model. We initially assume that $G$ is constant and later extend the baseline model to analyze an imperfect observability scenario under which the service provider can make some effort to make it less likely for the client to detect information poaching. The service provider essentially faces an economic trade-off. The service provider can make some effort to reduce the likelihood of detection by his client. However, his effort will incur some costs and thereby reduce his gain.

Many extant relational contract models aim to study optimal incentive provision in the classic agency theory framework, where the key issue is for the principal to induce the optimal effort from the agent. Gibbons [31] suggests that relational contract theory should go beyond the classic agency theory framework and discusses its potential for new applications to interfirm supply transactions. Unlike these relational contract models in labor economics, many incentive contract models in marketing channel and supply chain management focus on mitigating business partners’ opportunism (in strategic pricing, inventory management, or information exchange). The primary goal of our model is to study the role of relational contracts in mitigating one form of opportunism. So the focus here is to analyze how relational incentive provision mitigates the service provider’s propensity to misappropriate information.

In our model, information misappropriation, as an incentive problem, is always welfare damaging, that is, $L > G$. In addition, to avoid the uninteresting scenario where protecting information is always a dominated strategy, we let $c < \min(L, S)$ so that protecting information may potentially improve efficiency and facilitate outsourcing. Our model adopts an incomplete contract approach by assuming that information
misappropriation and the resultant loss $L$ are ex post unverifiable to a third party (e.g., the court), which imposes a severe enforceability constraint on explicit incentive contracting.\textsuperscript{4} The one-shot sourcing game described above is common knowledge, and its order of play and other detailed features are listed in Box 1. It is worth noting that the structure of our game allocates virtually all bargaining power to the client, consistent with the fact that sourcing markets in most cases are very competitive and many client companies are industry leaders looking for cost-reduction opportunities. Nevertheless, more complicated bargaining mechanisms can be used to enrich our model in those situations where bargaining power is more evenly distributed between the two sourcing parties. We will discuss the implications for more evenly distributed bargaining power when we extend our model to consider the impact of a growth option associated with the relationship.

We use the concept of subgame perfection to characterize the perfect equilibrium for our one-shot sourcing game. We solve this finite-horizon dynamic game by backward induction, the standard technique for solving this type of game. Starting from step 4 in Box 1, the service provider will always exploit transferred unprotected information because $m + G > m$. Knowing this and the fact that $S - c > S - L$, the client will always protect her information at cost $c$ before transferring it to him in step 3. The provider knows that he will get $m$ if he stays in the game and 0 otherwise, so he will accept any offer $m \geq 0$ in step 2. Knowing this, the client will always offer him $m = 0$ because she has virtually all the bargaining powers (she makes a take-it-or-leave-it offer in step 1). Note that our mode implicitly assumes $m \geq 0$. Otherwise a second equilibrium ($m = -G$) arises when $c > L - G$. We describe the equilibrium path and the two parties’ strategy combination in the following proposition:

**Proposition 1 (The Perfect Equilibrium of One-Shot Sourcing Game):** The following strategy combination characterizes the unique perfect equilibrium of the one-shot sourcing game:

**The Client’s Strategy:** offers $m = 0$, always protects her information.

**The Service Provider’s Strategy:** accepts any offer $m \geq 0$, always exploit the transferred information if it is unprotected.

**The Equilibrium Path:** The client offers the provider 0, and he accepts. She then chooses to protect her information before it is transferred, and consequently he gets no chance to exploit the transferred information.

**The Equilibrium Payoffs:** the client gets $S - c$, and the service provider gets 0.

**Proof of Proposition 1:** Proposition 1 describes not only the strategies played in the equilibrium but also the strategies off the equilibrium path, which makes the equilibrium well specified in every subgame of the one-shot sourcing game. It is easy to see that no player will be strictly better off by unilaterally deviating from the equilibrium path, and it is even more straightforward to confirm that the relevant strategies specified above constitutes a Nash equilibrium in every subgame. Therefore, the equilibrium is subgame perfect. To prove its uniqueness,
we need to rule out all other Nash equilibria as subgame perfect ones. First, 
$m > 0$ will not be played in any Nash equilibrium because some player always 
has incentives to unilaterally deviate under this scenario. Second, $m = 0$ does 
support two Nash equilibria, one of which is the perfect equilibrium described 
above. The other Nash equilibrium requires the service provider to reject any 
offer $m \geq 0$, which is obviously not a credible threat off the equilibrium path. It 
is therefore not subgame perfect. Q.E.D.

While the maximum surplus available from the one-shot sourcing transaction is 
$S$, the joint surplus received by the service provider and the client in equilibrium is 
$S - c$. The service provider’s incentive to misappropriate the transferred information 
reduces the joint surplus by $c$, the amount of money that the client spends to protect 
she information. This efficiency loss occurs because of the contractibility constraint 
imposed by the incomplete contract environment. If information exploitation is ex post 
verifiable, this incentive problem can be easily solved. To achieve this goal, the client 
can use explicit contingent contracts that either penalize poaching or reward good 
behavior. Unfortunately, in our one-shot sourcing game where poaching is not con-
tractible, any threat of penalty or promise of reward depending on ex post verifiability 
is not credible. If this one-shot sourcing game accurately portrays most real-world 
sourcing transactions, sourcing clients should spend a significant amount of resources

Box 1. The One-Shot Sourcing Game

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<thead>
<tr>
<th>One-Shot Sourcing Game</th>
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<tr>
<td>Players:</td>
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<td>The Client and the Service Provider</td>
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<tr>
<td>The Order of Play:</td>
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<tr>
<td>1. The client offers the service provider $m$ ($m \geq 0$) for one-shot sourcing transaction.</td>
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<tr>
<td>2. The service provider decides whether to accept it or reject it. If he rejects it, the game ends. Otherwise, the game goes to the next step.</td>
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<tr>
<td>3. The client transfers some valuable information to the service provider. She decides whether to protect her transferred information at cost $c$ or not.</td>
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<tr>
<td>4. The service provider receives the transferred information and delivers the service. He cannot exploit any protected information from his client. However, he has the option to misappropriate the transferred information if it is not protected.</td>
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<tr>
<td>Payoffs:</td>
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<td>- If the service provider rejects the client's offer in step 2, both players receive 0.</td>
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<td>- If the client chooses to protect her transferred information, she will get a payoff of $S - c - m$, and the service provider's payoff is $m$.</td>
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<tr>
<td>- If the client chooses not to protect her transferred information and the service provider chooses not to exploit the unprotected information, the client will get $S - m$ and the service provider will get $m$.</td>
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<tr>
<td>- If the client chooses not to protect her transferred information and the service provider chooses to exploit the unprotected information, the client will get $S - m - L$ and the service provider will get $m + G$.</td>
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in safeguarding their information because their service providers always try to exploit it. In actuality, many clients do not spend a lot of resources to protect their information, and many service providers rarely misappropriate their clients’ information. This one-shot game fails to recognize the fact that, as technological advance continues to reduce the transaction costs for interfirm collaborations, more and more sourcing transactions are executed by companies with enduring and hand-in-glove sourcing relationships. These sourcing partners, relying on implicit and self-enforcing relational agreements, usually interact repeatedly and behave cooperatively under “the shadow of the future” [10, 49].

The Repeated Sourcing Game

We develop a repeated sourcing game (hereafter called the “baseline model”) to analyze relational sourcing and the associated implicit contracts. The main results from our baseline model (Propositions 1 and 2) are similar to the major insights from previous theoretical studies that use repeated games to model self-enforcing relational contracts [4, 6, 12, 18, 31, 54]. Economists have long believed that repeated interactions can significantly influence incentive structures and consequently the market dynamics [12, 50, 60, 69]. Moreover, recent experimental evidence strongly supports game theorists’ belief that repeated games are very effective in studying recurrent market interactions without third-party enforcement [10, 11]. The repeated sourcing game developed here is an infinitely repeated game, with our one-shot sourcing model as its stage game. We study stationary relational contracts in the stable stage of the sourcing relationship (we will describe the three stages of the sourcing relationship later). Because of the static nature of the repeated sourcing game, the relational incentive contracts characterized here will not be history dependent. Nevertheless, we will analyze relational incentive provision under two history-dependent scenarios later in this paper. After each sourcing transaction concludes, the repeated game continues with probability $p$ and ends with probability $1 - p$. This probability of continuation nicely captures the notion that no sourcing relationships last forever in the real business world and their termination dates are mostly uncertain. In many repeated game models, $p$ is substituted by a common discount factor. Information misappropriation by the service provider continues to be unverifiable in our repeated sourcing game, which effectively rules out third-party enforcement. In addition, we assume that transferred information is perishable so that the service provider cannot misappropriate the transferred information that was not exploited in any previous transaction (we will later relax this assumption to analyze a more general scenario where the transferred information does not perish for $N$ rounds of transactions). The repeated sourcing game’s order of play and other detailed features are listed in Box 2, and they are common knowledge.

We first analyze a benchmark scenario where there is no prospect for a relationship expansion. In our repeated sourcing game, the client and the service provider implicitly agree to cooperate to attain the maximum joint surplus $S$, that is, the service provider promises never to misappropriate the client’s information, and she agrees to share the surplus with him by offering him $m^*$ for each transaction. In this model, the two
sourcing parties can easily coordinate on the implicit agreement through cheap talk (for discussions of the cheap talk game and its application to interfirm coordination, see [29, 55]). It is worth noting that this implicit agreement (a relational contract) cannot be enforced by a third party in our model and, in fact, must be self-enforcing. To enforce their implicit agreement, they play trigger strategies to punish any deviation from a relational sourcing equilibrium characterized in the following proposition:

**Proposition 2 (The Relational Sourcing Equilibrium):** In the repeated sourcing game that extends the one-shot game indefinitely with probability $p$, the two parties can both be better off in a relational sourcing equilibrium. In the equilibrium the client always offers the service provider $m^* = G(p^{-1} - 1)$ and chooses not to protect her information, and he never exploits her unprotected information, thereby increasing both parties’ expected payoffs over the one-shot game. This Pareto improvement can be achieved if $c \geq G(p^{-1} - 1)$. The trigger strategies are characterized below:

**The Client’s Trigger Strategy:** The client offers the service provider $m^* = G(p^{-1} - 1)$ for each transaction and chooses not to protect her information. However, if she observes that the service provider exploited her unprotected information, she will play her perfect equilibrium strategy of the one-shot sourcing game forever.

**Box 2. The Repeated Sourcing Game (Baseline Model)**

<table>
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<tr>
<th><strong>Repeated Sourcing Game</strong></th>
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**The Order of Play**
1. The client offers the service provider $m$ ($m \geq 0$) for each sourcing transaction.
2. The service provider decides whether to accept it or reject it. If he rejects it, the game ends. Otherwise, the game goes to the next step.
3. The client transfers some valuable information to the service provider. She decides whether to protect her transferred information at cost $c$ or not.
4. The service provider receives the transferred information and delivers the service. He cannot exploit any protected information from his client. However, he has the option to misappropriate the transferred information if it is not protected.
5. With probability $p$ the game returns to step 1 and repeats, and it ends with probability $1 - p$.

**Payoffs from Each Transaction (Not Total Payoffs from Repeated Transactions)**
- If the service provider rejects the client’s offer in step 2, both players receive 0.
- If the client chooses to protect her transferred information, she will get a payoff of $S - c - m$, and the service provider’s payoff is $m$.
- If the client chooses not to protect her transferred information and the service provider chooses not to exploit the unprotected information, the client will get $S - m$ and the service provider will get $m$.
- If the client chooses not to protect her transferred information and the service provider chooses to exploit the unprotected information, the client will get $S - m - L$ and the service provider will get $m + G$. 


The Service Provider’s Trigger Strategy: The service provider does not exploit the client’s unprotected information as long as she offers him \( m \geq G(p^{-1} - 1) \). If her offer is ever below \( G(p^{-1} - 1) \), he will always exploit her transferred information if it is not protected.

Proof of Proposition 2: We first prove that \( m^* \) satisfy both players’ incentive compatibility (IC) constraints. The client’s expected payoff will be \( (S - c)/(1 - p) \) if she chooses to play her perfect equilibrium strategy in the repeated game. So her IC constraint is \( (S - m^*)/(1 - p) \geq (S - c)/(1 - p) \Rightarrow m^* \leq c \). The service provider will exploit the unprotected information only if his short-term gains from poaching outweigh his long-term payoffs from cooperation. So his IC constraint is \( G \leq m^* p / (1 - p) \Rightarrow m^* \geq G(p^{-1} - 1) \). Note that \( m^* p / (1 - p) \) is the present value of all the future price premiums that he can gain in the relational sourcing equilibrium. It is easy to see that \( m^* \) satisfies both IC constraints when \( c \geq G(p^{-1} - 1) \). Next we prove that both players, given their trigger strategies, have no incentive to deviate from the equilibrium path. The client will not be better off by offering more than \( m^* \). If she offers below \( m^* \), the service provider will exploit her unprotected information. He also cannot be better off by exploiting her information when her offer is \( m^* \). Q.E.D.

When \( c < G(p^{-1} - 1) \), the client’s IC constraint is violated and the two sourcing parties will repeatedly play their perfect equilibrium strategies of the one-shot sourcing game, which consequently reduces the total expected surplus from \( S/(1 - p) \) to \( (S - c)/(1 - p) \). It is easy to see that, regardless of the values of \( c \) and \( G \), the relational sourcing equilibrium can be sustained as long as \( p \) is sufficiently close to 1. In our repeated sourcing setting, this implies that when the two sourcing parties perceive their sourcing relationship as very stable (this scenario usually arises when there is high level of mutual trust between the two partners), they should always behave cooperatively and not misappropriate transferred information. When \( p \) is not close to 1, either a significant increase in \( G \) (benefits from poaching) or a significant decrease in \( c \) (costs of protecting information) could destroy the viability of the relational sourcing equilibrium. Interestingly, a lower information protection cost may not lead to a more efficient outcome in our model. This is because a lower information protection cost reduces the incentive for the client to cooperate with the service provider.

In our baseline model, we implicitly assume that information poaching can always be detected by the client. A natural extension of the model is to consider the scenario where the provider can make some effort to reduce the likelihood of being detected by his client as an information poacher. Denote the provider’s effort, his net gain from poaching information (costs of his effort subtracted) and the likelihood for the client to detect information poaching as \( e \), \( G(e) \), and \( H(e) \), respectively, where \( G(e) \) and \( H(e) \) both monotonically decrease in \( e \). Proposition 2.1 shows that, under this scenario the two parties could achieve Pareto improvement in a relational sourcing equilibrium that is qualitative similar to the one characterized in Proposition 2. Nevertheless, we obtain several new insights into the role played by the service provider’s effort to reduce the likelihood of detection.
Proposition 2.1 (The Relational Sourcing Equilibrium—An Extension): In the repeated sourcing game that extends the one-shot game indefinitely with probability \( p \), the two parties can both be better off in a relational sourcing equilibrium. This Pareto improvement can be achieved when \( c \geq G(e^*)(p^{-1} - 1)/H(e^*) \), where \( e^* = \operatorname{argmax}_e \{G(e)/H(e)\} \). In the equilibrium the client always offers the service provider \( m^* = G(e^*)(p^{-1} - 1)/H(e^*) \) and chooses not to protect her information, and the service provider never exploits her unprotected information.

Proof of Proposition 2.1: In this model extension, the client’s IC constraint remains \( (S - m^*)/(1 - p) \geq (S - c)/(1 - p) \Rightarrow m^* \leq c \). Because the service provider can make some effort to reduce the likelihood of detection, his IC constraint becomes \( G(e^*) \leq m^*pH(e^*)/(1 - p) \Rightarrow m^* \geq G(e^*)(p^{-1} - 1)/H(e^*) \). It is easy to see that \( m^* \) satisfies both IC constraints when \( c \geq G(e^*)(p^{-1} - 1)/H(e^*) \). Next we prove that both players, given their trigger strategies, have no incentive to deviate from the equilibrium path. The client will not be better off by offering more than \( m^* \). If the client offers below \( m^* \), the service provider will exploit her unprotected information and make effort \( e^* \) to reduce the likelihood of detection. Q.E.D.

Comparing the analytical results of Propositions 2 and 2.1 yields some interesting observations. First, these results are qualitatively similar. However, it becomes much harder to sustain a relational sourcing equilibrium when the service provider’s efforts can significantly reduce the client’s detection probability. Because \( m^* \geq m^* \), the parameter range that can sustain the relational sourcing equilibrium has become smaller. Consequently, this model extension generates several new managerial insights. For example, our results suggest that relational sourcing is more likely for those IT outsourcing relationships with effective monitoring mechanisms that make it very costly for the providers to avoid detection. Moreover, ceteris paribus, a client with a stronger detection capability enjoys more benefits from engaging in relational sourcing. These benefits include a better chance to achieve Pareto improvement through relational sourcing and a lower price premium paid to the service provider. Interestingly, the service provider may not necessarily benefit from a stronger capability of exerting efforts to avoid detection. While the service provider can gain a higher price premium in the relational sourcing equilibrium, he may end up losing the entire relational premium when the relational sourcing equilibrium becomes infeasible because of the more stringent IC constraints. Because incorporating the service provider’s effort into our model does not qualitatively affect the relational sourcing equilibrium, we use \( G \) as a constant in the remainder of this paper for notational simplicity.

One noticeable feature of the relational sourcing equilibrium, as compared to the perfect equilibrium in the one-shot sourcing model, is that the client always offers the service provider something more than zero. Why does the client willingly share rents with the service provider despite that fact that she can make a take-it-or-leave-it offer at the beginning of each transaction? Our model suggests that this “price premium” is necessary to make the implicit relational contract between the two sourcing parties self-enforcing (although constructed in different settings, some previous economic models yielded similar insights, e.g., [4, 50, 69]). This result is consistent with the
argument in Clemons and Hitt [19] that using competitive bidding mechanisms is likely to exacerbate the poaching problem.

Figure 1 illustrates three stages of the outsourcing relationship analyzed in our model. While the relational sourcing game we have developed so far (the baseline model) is a reasonable characterization of the stable outsourcing relationship in Stage 2, it is difficult to implement during the relationship-building stage. As the outsourcing partners are more likely to continue their relationship when they have a successful relationship for a longer period of time, it is reasonable to assume that the relationship continuation probability \( p \) increases over time in Stage 1. Assuming the bilateral relationship advances into the second stage after \( k \) rounds of sourcing transactions, we can model the relationship in Stage 1 as a finitely repeated game. Because \( p \) increases over time in Stage 1, implementing a relational contract with a bonus payment after each round of transaction may incur significant contracting and implementation costs (it essentially requires that both partners know the exact value of relationship continuation probability after each round of transaction). Instead, a single relational bonus payment payable to the service provider at the end of Stage 1 is a much more convenient and cost-effective way for incentive provision. Denoting \( p_0 \) as the relationship continuation probability at the beginning of Stage 1, a single relational bonus in the amount of \( G/p_0^k \) will be sufficient to overcome the service provider’s incentive to poach information during Stage 1. Because the present value of this one-time bonus is always greater than or equal to \( G \), it guarantees that at any time the provider will not be better off by poaching information. Note that this bonus may be more than enough if we know exactly how \( p \) increases over time during Stage 1. In many real-world situations \( L \gg G \) and \( L \gg S \). So unless the client has very precious information about how \( p \) evolves (an unlikely scenario during Stage 1), she needs to pay a bonus big enough to avoid the possibility of suffering a major loss from information poaching.

Recall that our model assumes that the transferred information perishes after each transaction. Otherwise the service provider can poach the accumulated information. Under this scenario, the service provider’s gains from poaching information may quickly increase over the first few transactions (during the first stage as shown in Figure 1) and then stabilize over time. We analyze this case in the following proposition:

**Proposition 2.2 (Relational Price Premium When Information Perishes After \( N \) Rounds):** When \( c \geq G(p^{1-N} – 1) \), the client always offers the service provider \( m^*(N) = G(p^{1-N} – 1) \) and chooses not to protect her information, and he never exploits her unprotected information.

**Proof of Proposition 2.2:** We first prove that \( m^*(N) \) satisfies both players’ IC constraints. The client’s expected payoff will be \((S – c)/(1 – p)\) if she chooses to play her perfect equilibrium strategy in the repeated game. So again her IC constraint is \([S – m^*(N)]/(1 – p) \geq (S – c)/(1 – p) \Rightarrow m^*(N) \leq c\). The service provider will exploit the unprotected information only if his short-term gains from poaching outweigh his long-term payoffs from cooperation. Moreover, if he decides to exploit unprotected information, he can poach information accumulated over \( N \)
The continuation probability is unstable (and likely gradually increasing over time). So this stage is not characterized as a repeated game. However, relational incentives can be provided through a relational bonus at time 1. This bonus should be sufficient to overcome the service provider’s incentive to poach information at any time during this stage. This bonus is subject to the client’s reneging constraint that is determined by what happens in Stages 2 and 3.

Repeated game models can be used to characterize the second stage where continuation probability is assumed stable. Our baseline repeated sourcing model focuses on applying the insights of Folk Theorem and earlier economic models of relational contracts (Propositions 1 and 2). Proposition 3 highlights the flexibility of paying relational bonuses at different frequencies. The baseline model is extended to include the possibility of a relationship expansion at an uncertain time $t = 2$. Proposition 5 shows that how the expected incremental surplus from a potential relationship expansion could facilitate relational incentive provision prior to the expansion. The main insight from Propositions 6 and 7 is that the flexibility of paying relational bonuses at different frequencies remains, but a more optimistic client will have an incentive to make bonus payments as infrequently as possible. Proposition 8 generalizes Proposition 6 and demonstrates, as long as there is tiny difference in beliefs, relational bonuses only take two forms: the client pays a premium price (a less salient form of relational bonus) or she defers the bonuses as long as possible (she may not need to pay them at all as long as the shadow of the future remains sufficiently large).

Three types of exogenous events that could trigger the relationship expansion, of which two can be motivated by the real options literature. There are valuable growth options associated with the relationship expansion. In an unstructured environment like Stage 3 where there are too many unknowns, growth options can nicely capture the value of future growth after the expansions without imposing too many assumptions on what happens after the relationship expansion. This framework also highlights why real options associated with a relationship may play a positive role in relational incentive provision.

**Figure 1.** Three Stages of the IT Outsourcing Relationship: A Modeling Framework
rounds of transactions because information only perishes after $N$ rounds. So his IC constraint is $G + Gp + Gp^2 + \ldots + Gp^N \leq m'(N)p^{N+1}/(1-p) \Rightarrow m'(N)p^{N+1}/(1-p) \geq G[1 + p(1 - p^{N+1})/(1 - p)] \Rightarrow m'(N) \geq G(p^{1-N} - 1)$. It is easy to see that $m'(N)$ satisfies both IC constraints when $c \geq G(p^{1-N} - 1)$. Q.E.D.

Information accumulated over time, as Proposition 2.2 suggests, makes it more difficult for the two parties to engage in cooperative relational sourcing. Essentially, the service provider can misappropriate information accumulated over many rounds of transactions. As a result, the client has to share the surplus more generously to satisfy his more restrictive IC constraint. However, because of her option to play uncooperatively by protecting her information at cost $p$, she will never pay him more than $c$, which makes the relational sourcing equilibrium unlikely to hold when transferred information does not perish over many rounds of transactions. Therefore, a sourcing client with low information protection cost will likely to protect her information in situations where large amount of transferred information could accumulate over time.

Because $p$ is assumed to be stable during the second stage, we can characterize a series of payoff-equivalent relational bonus contracts. For notational simplicity, we maintain the assumption that information perishes after one round through the remainder of the paper. Because the offered payment can be postponed using bonus contracts, a reneging problem may emerge when the client has an incentive not to honor the payment offered to the service provider (because information poaching is assumed to be an unverifiable event ex post, any payment contingent on this event cannot be enforced by a third party, which justifies the reneging risk in relational contracting). The client’s reneging constraint becomes a key incentive issue when we implement the relational sourcing equilibrium using relational bonus contracts, arguably the most commonly studied contract choice in relational contracting literature (e.g., Gibbons [31] demonstrates that the idea of relational bonuses is readily applicable to interfirm supply transactions.) In our baseline model, it is reasonable to assume that relational sourcing will not survive the client’s reneging on promised payments. So the client has no incentives to renege on a promised bonus payment unless the reneged payment is greater than what she can gain from relational sourcing. Proposition 3 characterizes a series of relational bonus contracts under this reneging constraint:

**Proposition 3 (The Relational Bonus Contracts):** The two sourcing partners can agree on a relational bonus contract as long as $c \geq G(1 - p)$. Under the contract, after every $i \in \{1, 2, \ldots, J\}$ rounds of transactions without poaching, the client pays the service provider a bonus $m_i^* = G(p^{i} - 1)$, where $J$ satisfies $G(p^{J} - 1) \leq c/(1 - p) - G < G(p^{J-1} - 1)$. These relational bonus contracts are payoff equivalent.

**Proof of Proposition 3:** When the client pays the service provider a relational bonus after every $i$ rounds of transactions, the service provider’s IC constraint becomes $G \leq m_i^*/(1-p) \Rightarrow m_i^* \geq G(p^{i} - 1)$. Because $G = m_i^*/(1-p)$, the client’s IC constraint becomes $S/(1-p) - G \geq (S - c)/(1-p) \Rightarrow G(1-p) \leq c$. In addition, the client will have an incentive to renege on the relational bonus
payment when \( m^* > c/(1 - p) - G \). As \( m^* \) increases exponentially in \( i \), it is easy to see that there is a threshold \( J \) above which the reneging constraint will be binding. These bonus contracts are payoff equivalent because the two sourcing partners’ expected payoffs are the same, that is, for any \( i \in \{1, 2, \ldots, J\} \), we have \( m^*p/(1 - p) = G \). Q.E.D.

Proposition 3 demonstrates that, as long as the reneging constraint is not binding, the outsourcing partners can coordinate on any relational bonus contract among a series of payoff equivalent ones. Nevertheless, the viability of these relational bonus contracts requires that the client’s cost to protect her information is not too small. Otherwise, she would always protect her information. As we will show in the following section, the sourcing dyads are more likely to use a relational contract when they share the belief that the scope of their relationship could be significantly expanded in the future.

The Shadow of Future Relationship Growth

To embrace the notion that strategic outsourcing relationships usually have the potential to be significantly expanded as companies adapt to ever-changing business conditions, we extend our baseline relational sourcing model to analyze the impact of a relationship expansion that separates Stages 2 and 3 in our modeling framework. In an insightful paper, Fichman [30] conceptually demonstrates the interactions among organizational learning, adaptation, and the real options associated with technology platform adoption. Li [57] analyzes the interplay among these factors in a continuous-time stochastic model.

In our generalized three-stage model, the two outsourcing partners start their outsourcing relationship with the shared belief that their relationship could be expanded when some exogenous event occurs in the future. However, because expanding the scope of collaboration usually entails transferring a significant amount of highly sensitive and valuable information, the incentive problem caused by information misappropriation could be considerably exacerbated. Early studies have long pointed out that information poaching becomes an increasingly costly incentive problem as the scope of information-intensive collaboration expands [19, 20, 39]. We assume that the client will not be better off in an expanded relationship where significant resources have to be spent to protect the additional information that needs to be transferred. So the expanded outsourcing relationship has to be sustained by some relational sourcing equilibrium that does not entail information protection. In our model, the sourcing partners initially collaborate on a relatively small scope because the expected joint surplus from the relationship expansion is too small to sustain any relational sourcing equilibrium. However, the scope of their collaboration could be expanded in a mutually beneficial way sometime in the future.

To characterize the shadow of future relationship growth, we extend our model by introducing a variable \( \theta \in [0, 1] \). We use \( \theta \) to characterize the probability of the emergence of some exogenous event that favors relationship growth and thus justifies a relationship expansion. The outsourcing partners may find a relationship
expansion mutually beneficial when any of the following three types of exogenous events occurs.

*First type:* events that directly result to increase the expected joint surplus. Examples of these events include significantly favorable movement in foreign exchange rates and a significant drop in IT costs (e.g., significant drop in bandwidth price, IT hardware/software costs).

*Second type (growth options related):* events that generate high variance opportunities. Examples include major technology breakthroughs that facilitate/enable a larger scale of IT outsourcing (electronic data interchange, Internet/Web technologies, enterprise resource planning, customer relationship management, and more recently, cloud computing [64] and mobile computing); major industrial regulation changes/deregulation. The outsourcing partners have stronger incentives to expand their relationship as the growth options associated with the expanded relationship become more valuable. The extant real options literature also suggests that growth options become more valuable with the emergence of high variance opportunities (e.g., [30, 61]).

*Third type (also growth options related):* events that trigger higher competitive pressure or increase the likelihood of new entrance. As pointed out by Cachon and Harker [13], industry competition plays a major role in influencing firms’ outsourcing strategies. The outsourcing partners will have an incentive to expand their relationship when such expansions can lead to strategic preemption which, as emphasized by Kulatilaka and Perotti [51], will increase the value of growth options in the future. For the second and the third types of events, it is reasonable to assume that multiple relationship expansions may occur after the first relationship expansion. Our framework accommodates this possibility by focusing on the future growth options associated with the first relationship expansion. So for a highly unstructured environment like Stage 3, we think that it is reasonable to conceptualize future expansion opportunities (the second and the third types discussed above) as growth options.

Recall that the outsourcing relationship continues with probability $p$ in our repeated sourcing game. In our extended model, with probability $p(1-\theta)$ the sourcing partners have no incentive to expand their relationship and thus their relationship continues with the same scope. After each round of transaction, with probability $p\theta$ an exogenous event occurs and the sourcing partners find it mutually beneficial to expand their relationship. Under this scenario, the client has to transfer a significant amount of new information. During each period after the relationship expansion, the service provider can gain $G + G'$ if he decides to poach the transferred information (so $G'$ represents the additional gains from poaching the newly transferred information). After the relationship expansion, the joint surplus from each transaction is endogenously determined. There are at least two reasons why we model history-dependent gains from the relationship expansion. First, previous studies from the marketing literature have suggested that, as a business relationship matures, the levels of trust and commitment grow and fairness becomes a more important concern [2, 21]. Consequently, the service provider expects to benefit more from a relationship expansion that occurs later. Second, previous studies from the management literature have shown that, as a business relationship matures, partners tend to develop stronger relational capabilities to
exploit new business opportunities (e.g., [28]). So it is reasonable for the two sourcing partners to expect to gain more from a later relationship expansion. We characterize the history-dependent gains from the relationship expansion as $\beta S'\alpha^{T/T}$. As a result, the service provider’s expected gain asymptotically approaches $\beta S'$ over time, where $\beta$ is the service provider’s share of surplus ($S'$) every period after the expansion. It is easy to see that the lowest expected gain will be $\alpha \beta S'$ if the expansion occurs after the first round (i.e., $T = 1$). We first analyze the scenario where the service provider’s gains from poaching the transferred information may be overwhelmed by his expected gains from cooperating without poaching.

**Proposition 4 (Relational Bonus Unnecessary When Expansion Provides Sufficient Incentives):** When

$$\Upsilon(\alpha, \beta) = \sum_{T=1}^{\infty} \frac{p\theta \beta S'\alpha^{T/T} (p(1 - \theta))^{T-1}}{1 - p} > G,$$

the client does not need to pay any relational bonus to the service provider before the relationship expansion, and the service provider has no incentive to poach the transferred information. Ceteris paribus, this condition becomes less restrictive as $\alpha$ or $\beta$ increases.

**Proof of Proposition 4:** Suppose that the expansion occurs after $T$ rounds of transactions. The service provider’s expected gain (without discounting) from the expansion is $\beta S'\alpha^{T/T} (1 - p)$. Given the continuation probability $p(1 - \theta)$, we can calculate the present value of the service provider’s expected gain from the potential relationship expansion as

$$\Upsilon(\alpha, \beta) = \sum_{T=1}^{\infty} \frac{p\theta \beta S'\alpha^{T/T} (p(1 - \theta))^{T-1}}{1 - p}.$$

This present value must be greater than $G$ to overwhelm the service provider’s incentive to poach information. The last part of this proposition can be proved using the comparative statics results $\partial \Upsilon / \partial \alpha > 0$ and $\partial \Upsilon / \partial \beta > 0$. Q.E.D.

Proposition 4 suggests that the relational bonus is unnecessary when the service provider expects to gain significantly from the potential expansion. Moreover, a service provider expecting a more equitable relationship in the future is less likely to poach information opportunistically. A service provider is also less likely to behave opportunistically if the two parties expect to develop their capabilities more quickly to exploit the full potential of the relationship expansion.

For the remainder of the paper the analysis focuses on the scenario in which, after the relationship expansion, the service provider’s expected gains from poaching the transferred information dominates his maximum expected gains without poaching, that is, $\beta S'/(1 - p) < G + G'$. As characterized in Proposition 2, the expanded relationship can be sustained by a relational sourcing equilibrium where the service provider’s expected payoff from the expanded relationship is $G + G'$ (note that the service provider can gain $G + G'$ by poaching the client’s information. To compensate him for
not poaching information, the client has to pay him at least $G + G'$). The following proposition demonstrates how “options thinking” on relational adaptation impacts the sourcing partners’ strategies prior to the relationship expansion:

**Proposition 5 (The Relational Sourcing Equilibrium Prior to the Expansion):**

When $G(p^{-1} - 1) \leq G'\theta$, the client does not need to pay any relational bonus to the service provider before the relationship expansion, and the service provider has no incentive to poach transferred information. When $G'\theta < G(1 - p)/p \leq G'\theta + c/p$, the client pays the service provider a bonus $n^* = G(p^{-1} - 1) - G'\theta$ after each transaction and he never poaches the transferred information in equilibrium.

**Proof of Proposition 5:** Because the service provider’s expected payoff at the time of relationship expansion is $G + G'$, his expected payoff from the relationship expansion can be shown as

$$
\rho \theta (G' + G) \sum_{i=0}^{\infty} p^i (1 - \theta)^i = \frac{\rho \theta (G' + G)}{1 - p(1 - \theta)}.
$$

It is easy to see that, before the relationship expansion, he has no incentive to poach the client’s transferred information when $p \theta (G' + G)/(1 - p(1 - \theta)) \geq G \Rightarrow G' \theta \geq G(1 - p)/p$. Otherwise the client has to pay him a relational bonus after each transaction without information poaching. Denote the relational bonus as $n^*$. For the client not to protect her information, $n^*p$ has to be less than the client’s information protection cost $c$. Taking advantage of the recursive structure of our model, we have the following condition under which no poaching occurs in equilibrium: $G = pn^* + p\theta (G' + G) + p(1 - \theta)G \Rightarrow n^* = G(1 - p)/p - \theta G'$. Q.E.D.

One immediate implication for Proposition 5 is that a cooperative outsourcing relationship, during Stage 2, may not entail any form of relational bonuses (or alternatively price premium) as long as business partners understand that they may both benefit from potential relationship expansions in the future. Moreover, the prospect for a significant relationship expansion could make it highly likely for the outsourcing partners to behave cooperatively and engage in relational sourcing. Recall that Proposition 2 shows that the relational sourcing equilibrium cannot be sustained when it costs the client very little to protect the transferred information. Proposition 5 suggests that, when it is likely for the scope of an outsourcing relationship to be expanded, even an outsourcing client with very low information protection cost may not have incentives to protect her transferred information. In situations where future relationship expansion is not very likely (or the service provider expects limited gains from an expanded relationship), relational sourcing without information protection is still likely to occur because relational equilibrium can be sustained by smaller relational bonuses.

As shown in Proposition 3, when the frequency of relational bonus payments is endogenized, the outsourcing partners can coordinate on a set of payoff equivalent relational bonus contracts. Can they coordinate on a set of relational bonus contracts with different payment frequencies when they both understand that there is some likelihood for a future relationship expansion? The following proposition provides a positive answer.
Proposition 6 (The Relational Bonus Contracts Prior to the Expansion): The two sourcing partners can agree on a relational bonus contract when $0 < G(1 - p) - G'\theta p \leq c$. Under the contract, after every $i \in \{1, 2, ..., K\}$ rounds of transactions without poaching, the client pays the service provider a bonus

$$n_i^* \frac{1 - p'(1 - \theta)^i}{1 - p(1 - \theta)} p^{-i} (1 - \theta)^{-i},$$

where $n^* = G(1 - p)/p - \theta G'$. These relational bonus contracts are payoff equivalent.

Proof of Proposition 6: When the client pays the service provider a relational bonus after every $i$ rounds of transactions, the service provider’s IC constraint leads to the following equilibrium equation (note that we here take advantage of the recursive structure of our model):

$$G = n_i^* p'(1 - \theta)^{i-1} + p\theta (G + G') \frac{1 - p'(1 - \theta)^i}{1 - p(1 - \theta)} + p'(1 - \theta)^i G.$$

Rearranging the equation, we have

$$n_i^* = \frac{G(1 - p) - p\theta G'}{p'(1 - \theta)^{i-1}} \frac{1 - p'(1 - \theta)^i}{1 - p(1 - \theta)} = \frac{n^* [1 - p'(1 - \theta)^i]}{[1 - p(1 - \theta)] p^{-i} (1 - \theta)^{-i}}.$$

To prove payoff equivalency, we need to show that the expected total amount of bonus payments prior to relationship expansion is independent of payment frequency (note that under all these relational bonus contracts the partners have the same expected payoff after the relationship expansion). For a bonus contact with payment frequency $i$, the expected total amount of bonus payments prior to relationship expansion is

$$n_i^* p'(1 - \theta)^{i-1} = \frac{n^* p}{1 - p'(1 - \theta)^i} = \frac{G(1 - p) - \theta G' p}{1 - p(1 - \theta)} = \frac{G(1 - p) - \theta G' p}{1 - p(1 - \theta)},$$

which is independent of $i$. In addition, these bonus contracts are viable only when the client’s IC constraint is satisfied as

$$\frac{S}{1 - p(1 - \theta)} - G + \frac{p\theta (G' + G)}{1 - p(1 - \theta)} \geq \frac{S - c}{1 - p(1 - \theta)} \Rightarrow G(1 - p) - p\theta G' \leq c.$$

Because $n_i^*$ increases exponentially in $i$, it is easy to see that there is a threshold $K$ above which the client’s reneging constraint will be binding. Q.E.D.

It is worth noting that, because the relationship expansion increases the client’s total expected payoffs, her reneging constraint becomes less restrictive compared to her constraint without the expansion option, that is,

$$\frac{S' p\theta + S - Sp}{(1 - p)(1 - p(1 - \theta))} - G \geq \frac{S}{1 - p} - G.$$
Again, when the frequency of relational bonus payments is endogenized, the outsourcing partners can select from a set of relational bonus contracts. Fortunately, because of payoff equivalency, it is not difficult for them to coordinate on a specific contract through cheap talk (e.g., [29, 55]). So far we have assumed that the two partners share the same belief about the likelihood of the future relationship expansion. However, when we slightly alter the information structure of our model by assuming that the two parties have heterogeneous beliefs on $\theta$, we may obtain fresh insights into how the outsourcing partners select one of these relational bonus contracts.

**Contract Selection Under Heterogeneous Beliefs**

In the real business world, it would not be uncommon for the outsourcing partners to have different views on the likelihood of some exogenous event. For example, Bhargava and Sundaresan [8] highlight the critical role of heterogeneous beliefs in affecting the choice of pricing contracts. Relaxing the common prior assumption by modeling heterogeneous beliefs is particularly appropriate here because of limited learning during the early stages of a sourcing relationship. Under heterogeneous beliefs, the outsourcing client will not only pay attention to her assessment of the likelihood of a future relationship expansion but also to what the service provider expects about the likelihood of a future relationship expansion. For example, Proposition 4 suggests that the client is less likely to engage in relational sourcing and more likely to protect her transferred information when the service provider is less optimistic about the likelihood of a mutually beneficial relationship expansion. Ceteris paribus, the client prefers to build an outsourcing relationship with a service provider who sees a brighter prospect for a future relationship expansion.

The impact of different beliefs on the outsourcing relationship is more subtle in situations where relational sourcing is viable even without any prospect for a future relationship expansion. As shown in Propositions 3 and 6, when the frequency of relational bonus payments is endogenized, there are a set of payoff equivalent relational bonus contracts on any of which the sourcing partners can coordinate. Our next two propositions demonstrate that under heterogeneous beliefs, the outsourcing client has an incentive to select one relational bonus contract among a set of otherwise (under common beliefs) payoff equivalent ones.

**Proposition 7 (Contract Selection When the Service Provider Expects No Relationship Expansion):** When the service provider expects no future relationship expansion, a client with the belief that $\theta > 0$ has an incentive to offer the service provider a relational contract paying a bonus after every $J$ rounds of transactions.

**Proof of Proposition 7:** As demonstrated by Proposition 3, when the service provider expects no future relationship expansion, he is indifferent to a set of relational bonus contracts that pay him $m^i$ after every $i$ rounds of transactions, where $i \in \{1, 2, ..., J\}$. However, a client believing any likelihood of a future relationship expansion has different preferences on these relational contracts. Given her belief $\theta > 0$, she has an incentive to select a bonus contract that minimizes her
expected bonus payment prior to the expansion, that is, \( \min \psi(i) = m^*p^i(1 - \theta)^{i-1}/[1 - p^i(1 - \theta)^i] \). Because we have proved in Proposition 3 that \( m^*p^i(1 - \theta)^{i-1}/[1 - p^i(1 - \theta)^i] = G \), the objective function can be rewritten as \( \psi(i) = G(1 - p)(1 - \theta)^{i-1}/[1 - p(1 - \theta)^i] \).

We next prove \( \arg\min_{i(1,2,...)}\psi(i) = J \) through induction. First it is easy to see that \( \psi(1) > \psi(2) \). Assuming \( \psi(i) > \psi(i + 1) \), we have \( \psi(i) > \psi(i + 1) \Leftrightarrow p^{i+1}[(1 - \theta)^{i+1} - (1 - \theta)] + p[i - (1 - \theta)^{i+1}] < \theta \). To prove \( \psi(i + 1) > \psi(i + 2) \), we need to show \( p^{i+2}[(1 - \theta)^{i+2} - (1 - \theta)] + p^{i+1}[1 - (1 - \theta)^{i+2}] < \theta \), which is true because \( p^{i+2}[(1 - \theta)^{i+2} - (1 - \theta)] + p^{i+1}[1 - (1 - \theta)^{i+2}] = p^{i+2}[1 - (1 - \theta)^{i+2}] > 0 \). Q.E.D.

We use a numerical example in Table 1 to illustrate the main analytical results of our model. Recall that we discussed the IT outsourcing relationship between IBM and Daishi Bank in the introductory section. In our example, a client like Daishi Bank outsources some of her IT functions to a service provider like IBM. The client expects to save $100,000 every month through this outsourcing relationship (i.e., \( S = 100,000 \)). Based on the values of all parameter, given in the table, the client needs to pay the provider $80,000 * (1/0.98 – 1) = $1,632.65 every month (the relational sourcing price premium) in order not to protect her information. Our numerical analysis also quantifies the resultant Pareto improvement. the client and the service provider can expect to gain ($5,000 – $1,632.65)/(1 – 0.98) = $168,367 and $80,000, respectively, from using relational sourcing. Table 1 further demonstrates the payoff equivalency of a series of relational bonus contracts. Because of the client’s reneging constraint, the longest bonus payment interval is 36 months. Table 1 shows that the present values of all the bonus contracts are the same. However, the payoff equivalency does not hold anymore when the two parties have different beliefs. In our example, the client expects that the probability of a relationship expansion after each month is 0.1 percent. Our simulation results clearly demonstrate that the present value of expected bonus payments monotonically increases in the frequency of relational bonus payments. As predicted by our model, the client has an incentive to pay infrequent bonuses as long as possible (36 months in this example).

Under many real-world scenarios, it is unlikely for a service provider to be absolutely certain that a future relationship expansion will not occur. Denote the service provider’s and the client’s beliefs on the likelihood of a future relationship expansion as \( \theta \) and \( \theta^c \), respectively. We assume that their different beliefs are common knowledge. It is worthwhile for us to analyze whether the client’s incentive to pay infrequent bonuses persists when she is just slightly more optimistic than the service provider about the prospect for the future relationship expansion. The following proposition provides a positive answer. Moreover, it demonstrates that, when the client is less optimistic than the service provider about the prospect for the expansion, she has an incentive to pay him frequent, albeit smaller bonuses.

**Proposition 8 (Contract Selection Under Heterogeneous Beliefs—General Results):** When the client is more optimistic than the service provider about the likelihood of a future relationship expansion, she has an incentive to offer him a relational contract paying bonuses as infrequently as possible. When she is less
Table 1. A Numerical Example of Relational Sourcing

<table>
<thead>
<tr>
<th>Parameter values</th>
<th>Relational sourcing price premium</th>
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</thead>
<tbody>
<tr>
<td>( S )</td>
<td>$100,000</td>
</tr>
<tr>
<td>( m^* )</td>
<td>$1,632.65</td>
</tr>
<tr>
<td>( \theta )</td>
<td>0 or 0.001</td>
</tr>
<tr>
<td>( G )</td>
<td>$80,000</td>
</tr>
<tr>
<td>( p )</td>
<td>0.98</td>
</tr>
<tr>
<td>( c )</td>
<td>$5,000 Pareto improvement</td>
</tr>
</tbody>
</table>

| Client's total expected gain from relational sourcing | $168,367.35 |
| Provider's total expected gain from relational sourcing | $80,000.00 |

Expected payoffs of relational bonus contracts
Greatest payment interval allowed by the reneging constraint: 36 months

<table>
<thead>
<tr>
<th>Bonus payment interval</th>
<th>Bonus</th>
<th>Present value of expected bonus payments (( \theta = 0 ))</th>
<th>Present value of expected bonus payments (( \theta = 0.001 ))</th>
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</thead>
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<tr>
<td>1</td>
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optimistic than the service provider about the likelihood of future relationship expansion, she has an incentive to pay him bonuses as frequently as possible.

Proof of Proposition 8: Recall that the service provider with belief $\theta$ is indifferent to a set of relational bonus contracts that pay him $n_i^*$ after every $i$ rounds of transactions, where $i \in \{1, 2, \ldots, K\}$. However, the client with a different belief $\theta^c$ has different preferences on these relational contracts. She has an incentive to select a bonus contract that minimizes her expected bonus payment prior to the future relationship expansion, that is,

$$\min_i \left[ \frac{n_i^* p^i (1-\theta^c)^{i-1}}{1 - p^i (1-\theta^c)^i} \right].$$

For notational simplicity, we define the expected value of all bonus payments as

$$\xi(i, \theta^c) = n_i^* p^i (1-\theta^c)^{i-1}/[1 - p^i (1-\theta^c)^i].$$

It would be tedious to use induction to directly prove

$$\forall 0 < \theta^c < \theta : \arg \min_{i \in \{1, 2, \ldots, K\}} \xi(i, \theta^c) = 1$$

and

$$\forall \theta < \theta^c < 1 : \arg \min_{i \in \{1, 2, \ldots, K\}} \xi(i, \theta^c) = K.$$

So we prove it using another approach. Based on the payoff equivalency result proved in Proposition 5, we have $\forall i \in \{1, 2, \ldots, K-1\} : \xi(i, \theta) = \xi(i + 1, \theta)$. So for any $i \in \{1, 2, \ldots, K-1\}$, we have

$$\frac{\xi(i, \theta^c)}{\xi(i+1, \theta^c)} = \frac{1 - p^{i+1}(1-\theta^c)^{i+1}}{p(1-\theta)(1 - p^i (1-\theta^c)^i)}.$$

Defining the following function $f(\mu) = 1 + (1-\mu)/(\mu - \mu^{i+1})$, where $\mu = p(1-\theta)$, we have $\partial f(\mu)/\partial \mu = -[1-(i+1)]\mu^i + i\mu^{i+1}/(\mu - \mu^{i+1})^2$. It is easy to prove $\phi(i) = 1 - (i+1)\mu^i + i\mu^{i+1} > 0$ through induction (note that $\phi(1) > 0$ and $\phi(i+1) - \phi(i) = (i+1)\mu^i(i+1)^2 > 0$). Therefore, we have $\partial f(\mu)/\partial \mu < 0$ and $\partial f(\mu)/\partial \theta > 0$. As a result, for any $i \in \{1, 2, \ldots, K-1\}$ we have

$$\forall 0 < \theta^c < \theta : \xi(i, \theta^c) < \xi(i + 1, \theta^c)$$

and

$$\forall \theta < \theta^c < 1 : \xi(i, \theta^c) > \xi(i + 1, \theta^c).$$

Q.E.D.

Proposition 8 provides some fairly general results on relational contract selection under heterogeneous beliefs. As these results hold even when the sourcing partners’ beliefs are very close to each other, they shed fresh light on the important issue of equilibrium selection in relational contract theory. Because multiple equilibria often emerge in repeated games, relational contract theorists have long paid close attention to
the issue of equilibrium selection/refinement (e.g., [4]). Nonetheless, traditional refinement criteria like payoff or risk dominance are often not applicable to many relational contracting settings. Therefore, relational contract theorists have always been struggling with the issue of the “plethora of equilibria in repeated games” and very often, selection of the efficient equilibrium is assumed without solid justification [32]. The results here show that, despite the availability of a set of payoff equivalent equilibria under common beliefs, most of them are not robust to a reasonable perturbation in the information structure of our model (i.e., allowing the client’s belief on the likelihood of the future relationship expansion to slightly differ from that of the service provider). Consequently, our analysis provides an example where slightly relaxing the common knowledge assumption severely restricts the range of robust equilibria (see [18] for another recent example).

In the context of relational outsourcing, Proposition 8 highlights the significant role played by outsourcing partners’ beliefs in influencing incentive provision and contract choices. It demonstrates how increased contract flexibility may lead to Pareto improvement that is unattainable under common beliefs. Under the scenario where the client is more optimistic than the service provider about the future relationship expansion, the client has to protect her transferred information when her IC constraint is not satisfied. With the flexibility to defer bonus payments, the client has a mechanism to improve her subjectively expected payoffs from relational outsourcing, which increases the likelihood of satisfying her IC constraint and ipso facto reduces the likelihood of inefficient information protection.

The strategic implications for differing relationship perceptions have been highlighted in the relationship management literature. For example, Vosgerau et al. [75] study the impact of inaccurate relational perceptions (beliefs) on relationship commitment. Their empirical evidence suggests that excess pessimism is much more common than overoptimism in business-to-business (B2B) relationships. Their study highlights one prominent difference between the relevant economics literature and organizational behavior literature. While “social psychologists and researchers in organizational behavior have stressed the beneficial role of positive illusions” [75, p. 208], Vosgerau et al. point out that “in the analytical decision literature, inaccuracy is theorized to have negative effects independent of the direction of perceptual error. For example, in game-theoretic formalizations of relational contracts (e.g., [6]), relational contracts are feasible only if the downstream party knows the upstream party’s characteristics” [75, p. 207]. In the context of IT outsourcing, we use heterogeneous beliefs to characterize the differing perceptions of relationship prospects. Our analysis is consistent with the empirical evidence in Vosgerau et al. [75], suggesting the beneficial role of positive illusions. For example, in our model, two sourcing parties with more optimistic expectations on the relationship expansion (and its resultant gains) are more likely to engage in mutually beneficial relational sourcing.

Showing the pervasiveness of differing perceptions in B2B relationships, Vosgerau et al. [75] justify the relevance of our study on business partners’ heterogeneous beliefs. As shown in our model, as long as there is a tiny difference in the outsourcing partners’ beliefs, relational bonuses can only take two forms: The client pays the service
provider a premium price (a less salient form of relational bonus) or she defers the bonuses as long as possible (she may not need to pay it at all as long as the shadow of the future remains sufficiently large), which suggests that the relational incentive provision is likely more pervasive than what we can observe. In other words, it is not easy to obtain substantial anecdotal evidence of “bonus” payments. Why? First, relational bonuses are informally promised payments not written in any formal contracts. Moreover, our analysis suggests that salient forms of relational bonuses are often not adopted. Second, as shown in our extended model with relationship expansions, a relational contract may not entail any relational bonus as long as the shadow of future relationship growth remains sufficiently large.

As discussed in the introduction, many outsourcing contracts observed in the real business world nowadays have long durations, flexibilities for renegotiation and relationship expansion, mechanisms for early termination and renewal, and so forth. These real-world contracts can be better viewed as contracting frameworks allowing business partners with heterogeneous information or beliefs to coordinate through learning and adaptation, thereby making their outsourcing relationship more likely to be successful in the long run. As Michael Mensik from Baker & McKenzie pointed out in Deloitte Consulting’s 2008 global outsourcing survey, “Deliverables (from outsourcing contracting) ought to be viewed as setting the tone and the framework for having a collaborative relationship. Signing the contract here is not the end but the beginning” [23, p. 22].

Discussions and Conclusions

Why is transferred information generally more vulnerable to exploitation in spot outsourcing transactions than in relational outsourcing transactions? Are companies more likely to engage in relational outsourcing when they see a brighter prospect for a future relationship expansion? Why is it beneficial to have a contract framework that provides flexibilities for business partners with different information or beliefs? Our study provides researchers with a repeated game framework within which these questions can be formally analyzed.

By looking beyond myopic payoff maximization and recognizing companies’ incentives to cooperate under the shadow of the future, our analysis sheds fresh light on the poaching problem associated with interfirm information transfers. Specifically, it shows that forward-looking sourcing partners can coordinate on some implicit relational contract that disciplines information exploitation and consequently improves joint surplus. Moreover, by incorporating “options thinking” into the analysis of relational contracting, our study highlights the significance of having an outsourcing partner with strong confidence in future relationship growth. This insight is consistent with what Confucius taught us a few thousand years ago in The Analects that “those whose courses are different cannot lay plans for one another” [53, p. 169]. One practical implication for outsourcing service providers is that, to better compete for higher-level strategic outsourcing deals, they need to convince their prospective clients that their interests are aligned in expanding the scope of the outsourcing relationship when
future development warrants. As reported by Sharma and Worthen [70], many Indian outsourcing giants, aiming at broadening their IT outsourcing service, are vigorously promoting the view that their interests are tightly aligned “in letter, spirit, and dollars” with their clients’ business and prosperity.

Our study moves one step forward toward a better understanding of the interplay between relational incentive provision and relationship evolution. Recent evidence from several industry surveys suggests that, during the early stages of many outsourcing relationships, outsourcing partners often agree on some contracting framework offering sufficient room for future adjustments and renegotiations (e.g., [23]). Our three-stage modeling framework recognizes the evolutionary path (building-stabilization-growth) of a typical outsourcing relationship. While repeated game models may not be appropriate to analyze relational incentive provision during Stage 1, when the relationship is unstable and quickly evolving, they can be used to characterize the second stage when the relationship becomes stable. Our analysis demonstrates how the expected incremental surplus from a potential relationship expansion could facilitate relational incentive provision prior to the expansion. By explicitly modeling heterogeneous beliefs of the outsourcing partners, our study also shows how some very minor belief difference could change the way in which a relational contract is implemented. In our extended model, as long as there is a tiny difference in beliefs, relational bonuses can only take two forms: The client pays the service provider a premium price (a less salient form of relational bonus) or she defers the bonuses as long as possible (she may not need to pay it at all as long as the shadow of the future remains sufficiently big), which suggests that relational incentive provision is likely more pervasive than what we can observe. To highlight the main insights of our study, we provide readers with a detailed comparison between our paper and several other relational contracting papers in Table 2.

While most economic models of relational contracts exclusively study stationary contracts (e.g., [4, 6]), studying history-dependent contracts can obviously highlight the significance of learning and adaptation. Although our paper mainly focuses on stationary relational contracts, it does cover two history-dependent cases (nonperishable information and endogenous gains from the relationship expansion). It is worth noting that our model does not analyze many other factors that may distort incentives in an IT outsourcing relationship. For those factors that can be verified ex post, formal incentive contracts can be used to address the related incentive issues. For example, in the case of software outsourcing, while there is asymmetric information about the benefits and development costs of the outsourced software system, efficient formal incentive contracts are viable because the benefits and costs are both observable ex post [78]. Consequently, in situations where some factors are ex post verifiable and others are not, we need to pay attention to the interplay between formal incentive contracts and relational contracts [16, 34, 45, 65]. In the context of our model, one future research direction is to study how the complementarities between formal contracting and relational contracts enhance firms’ capabilities in disciplining information poaching. For example, when the outsourcing client’s reneging constraint is very stringent, formal incentive payments can be used to reduce the relational bonuses so
that relational contracting remains viable (e.g., [31]). Because those factors that are hard to verify ex post, we can model them in a similar way as we model information poaching. Nevertheless, we also need to pay attention to the interplay among multiple factors. For example, under the scenario where both outsourcing parties can poach information (e.g., technology know-how, trade secrets) from each other, we need to keep the “mutual hostage situation” in mind when studying relational incentive provision. Another very important issue that often arises in interfirm relationships is holdup.

<table>
<thead>
<tr>
<th>Relational contracting papers</th>
<th>Focus of analysis</th>
<th>Main insights</th>
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<tbody>
<tr>
<td>Baker et al. [5, 6] and Gibbons [31]</td>
<td>Use infinitely repeated games to study stationary relational contracts within and between firms. Focus on the interplay among court-enforceable contracts, asset ownership, and relational contracts.</td>
<td>Relational contracts inside firms may allow firms to improve on market outcomes. The feasibility of relational contracts is often affected by asset ownership. Relational incentive provision is often limited by reneging constraints.</td>
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<tr>
<td>Levin [54]</td>
<td>Focuses on characterizing Pareto-optimal contracts in settings of moral hazard or hidden information.</td>
<td>It often suffices to consider only stationary contracts in which the principal promises the same payment in each period. However, stationary contracts are no longer effective when performance is subjectively evaluated.</td>
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<tr>
<td>Chassang [18]</td>
<td>Analyzes the joint dynamics of learning and cooperation using an infinitely repeated game with asymmetric information.</td>
<td>Demonstrates why incentive problems can lead players to stop learning inefficiently early. However, relationship routines can be established after learning is completed successfully, making relationships more resilient to shocks.</td>
</tr>
<tr>
<td>This study</td>
<td>Focuses on studying how a potential relationship expansion influences relational contracting. It also highlights the role played by differing beliefs in influencing coordination and relational incentive provision.</td>
<td>Demonstrates how the expected gains from a potential relationship expansion could facilitate relational incentive provision prior to the expansion. It further shows that a very minor belief difference could change the way in which a relational contract is implemented.</td>
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</table>
In Grossman–Hart–Moore’s classic framework, the holdup problem arises because of contractual incompleteness and asset specificity (e.g., [36, 43]). Their framework highlights the significance of property rights because they influence bargaining power in ex post contract renegotiation. Walden [76] investigates the property rights issue in the context of IT outsourcing. In our modeling framework, the service provider’s incentive to poach information may be reduced when he has to make significant relationship-specific investment. Under this scenario, it would be interesting to endogenize the service provider’s ex ante investment decision making. In such an extended model, relational contracting needs to achieve two objectives: to provide incentives for optimal ex ante investment and to eliminate incentives for information poaching.

Most theoretical papers on outsourcing contracts assume risk neutrality to avoid inessential analytical complications (e.g., [66, 78]). In our paper, risk neutrality plays a more important role because it makes it straightforward to analyze the equivalence between different bonus payment contracts. One major insight of our paper is that inconsistent preferences (because of different beliefs in our model) may play an interesting role in equilibrium selection. However, inconsistent preferences may also result from behavioral biases (e.g., risk aversion, loss aversion, hyperbolic discounting). Therefore, when risk neutrality is not assumed, some of these behavioral factors other than heterogeneous beliefs may play a similar role in equilibrium selection.

Harsanyi’s [42] pioneering work in Bayesian games has greatly enhanced our understanding of strategic coordination under information incompleteness. His incomplete information paradigm employs two basic assumptions, that is, common knowledge of rationality and common prior beliefs. While numerous theoretical and experimental studies have generated new implications by relaxing the assumption on rationality [15, 46, 59], much fewer studies have examined the impact of differing prior beliefs on business strategies (e.g., [26, 55, 74]). By allowing outsourcing partners to have different beliefs on the likelihood of a future relationship expansion, our study highlights the role played by differing beliefs in influencing interfirm coordination and relational incentive provision. Our analysis further shows that most equilibria obtained under the common belief assumption are not robust to the outsourcing client’s incentive to arbitrage under heterogeneous beliefs. This type of belief arbitrage, facilitated by the increased flexibility in relational contracting, could improve outsourcing efficiency by mitigating the incentive problem that leads to information poaching. It is our belief that more insights may emerge from studying the strategic implications for heterogeneous beliefs in other interfirm coordination settings.

NOTES

1. According to IBM’s news release, “the new contract will extend the outsourcing scope to include planning support, operation and maintenance for the information system and applications. Additionally, IBM will provide central processing unit (CPU) and software resources according to the mainframe usage needed for accounting or information related operations. The on demand model will provide optimal IT resources and flexibility based on business requirements. This support by IBM Japan will help Daishi Bank aggressively realize its business strategy to enhance profitability and maintain a sound business. The new agreement was signed in March

2. Many IT outsourcing clients, including some of the world’s largest companies, find it more and more difficult for them to execute an optimal outsourcing strategy in the very complex and dynamic global sourcing market. Some of these companies, increasingly dissatisfied with their outsourcing service providers, indicate that they are considering scaling down their future IT sourcing activities or prematurely terminating some ongoing IT sourcing relationships [22, 23, 77]. Focusing on a handful of outsourcing structural risks, both Deloitte’s [22] and Weakland’s [77] reports indicate that many outsourcing clients are seriously concerned about information confidentiality, knowledge loss, and intellectual property protection.

3. Chassang [18] proposed a relational contract model where incomplete information leads to partial learning and path-dependent equilibria. Unlike his model, which focuses on optimal learning, our approach emphasizes equilibrium refinement resulting from belief disparity or incomplete information.

4. See Hart and Moore [43] for detailed discussions of the ex post nonverifiability assumption of incomplete contract theory. Tunca and Zenios [73] study the competitive dynamics between procurement auctions and relational contracts in situations where incentive problems arise because of the nonverifiability of product or service quality.

5. We assume risk neutrality to avoid inessential analytical complications caused by \( p \). We can easily drop this assumption by replacing this probability with a common discount factor or by expressing all strategy payoffs in terms of their von Neumann–Morgenstern utilities. In the repeated game literature, there are two interpretations of \( p \). It can be interpreted as a common discount factor or as a continuation probability. The two interpretations are equivalent under risk neutrality.

6. Dutta and Radner point out that “this issue is particularly problematic in repeated moral hazard contracts since at some point the principal has an incentive to renege on his commitment” [27, p. 886]. Consequently, most relational contracts models explicitly characterize the principal’s reneging constraint (e.g., 4, 6, 31]). Levin clarified this issue by pointing out that “because contingent compensation is merely promised, there is a temptation to renege on payments” [54, p. 839]. Both Baker et al. [4] and Gibbons [31] characterize relational contracts as non–court enforceable contracts subject to reneging constraints. In our model, information poaching is unverifiable behavior and thus the promised bonus payments are noncontractible (note that the contractible part of the outsourcing payment has been normalized to zero; a similar modeling technique was used in Gibbons [31]). Suppose that the client offers the service provider a court-enforceable payment of $100 after each transaction. In addition, the client promises the provider a $20 bonus after each transaction without information poaching (this is essentially a relational bonus). Can the client renege on the $20 bonus when situation warrants? Yes. This is because no third party (e.g., the court) can enforce the relational bonus—that is, no third party can verify whether the provider has poached the client’s information or not.

7. As pointed out in Morris [62] and Morris and Shin [63], the common knowledge assumption may not be appropriate in many strategic situations where learning is limited. See Aumann [3] and Gul [37] for an interesting discussion of Harsanyi’s [42] common prior assumption in Bayesian games. Aumann [3] labels this assumption as “Harsanyi’s doctrine.” We agree with Gul [37] and Morris [62] that it should be defended as a working hypothesis rather than a doctrine.

REFERENCES


